Editorial

ON the 12th and 13th of August, Australia's amateur transmitters held their annual Remembrance Day Contest under the auspices of their national society, the Wireless Institute of Australia—the oldest radio society in Australia, and one of the oldest in the world.

In this contest, the amateurs resident in one state attempt to contact as many amateurs as possible in other states within the space of 24 hours. The state which wins the contest relies not only on the scores of its best six competitors, but on the proportion of its amateurs who took part.

Thus there is no individual winner of the contest, only a special cup held for one year by the state which amasses the highest score.

The contest was inaugurated after the last war as the amateurs' way of paying tribute to many companions and friends who lost their lives in it. It provides special opportunity of saying "we remember" with every contact made throughout the length and breadth of the land. Many old comrades-in-arms exchange brief greetings during the contest, each, no doubt, with a thought for a mutual friend who to this dear land of ours came back no more.

I think it was a stroke of genius which inspired those concerned to make this a contest without an individual winner. For it is just as much a celebration as a contest, and in such things individual performances don't much matter. In making their appearance on the air, even for a short time, each amateur pays his own tribute.

This contest, I think, will become the most important of all those in which we take part, and certainly it should be. There is a difference about it, an unspoken realisation of its significance, which no other contest can have. There is a splendid atmosphere of good fellowship with it, more reminiscent of a happy reunion than of a grim battle for points.

Those amateurs in whose honor the contest is held would, I am sure, be happy to know their names were linked with an event which can do so much to bring Australian amateurs together. Unfortunately, the great size of our country separates us by hundreds of miles. But we are never really separated as long as we are on the air, and we never needed the sense of our unity more than we do at the present time.

Don't let us forget this contest. This year there was a fine roll-up. See that next year and the year after we make it the highlight of our national life on the air.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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VOL. 12 No. 6

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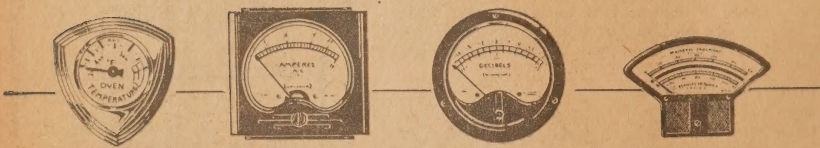
OUR COVER PICTURE

At the famous Greenwich Royal Observatory, founded by Charles II in 1675, an assistant turns the handle to open the roof of the solar building before photographing the sun. The Royal Observatory has now moved to Herstmonceux Castle, Sussex.



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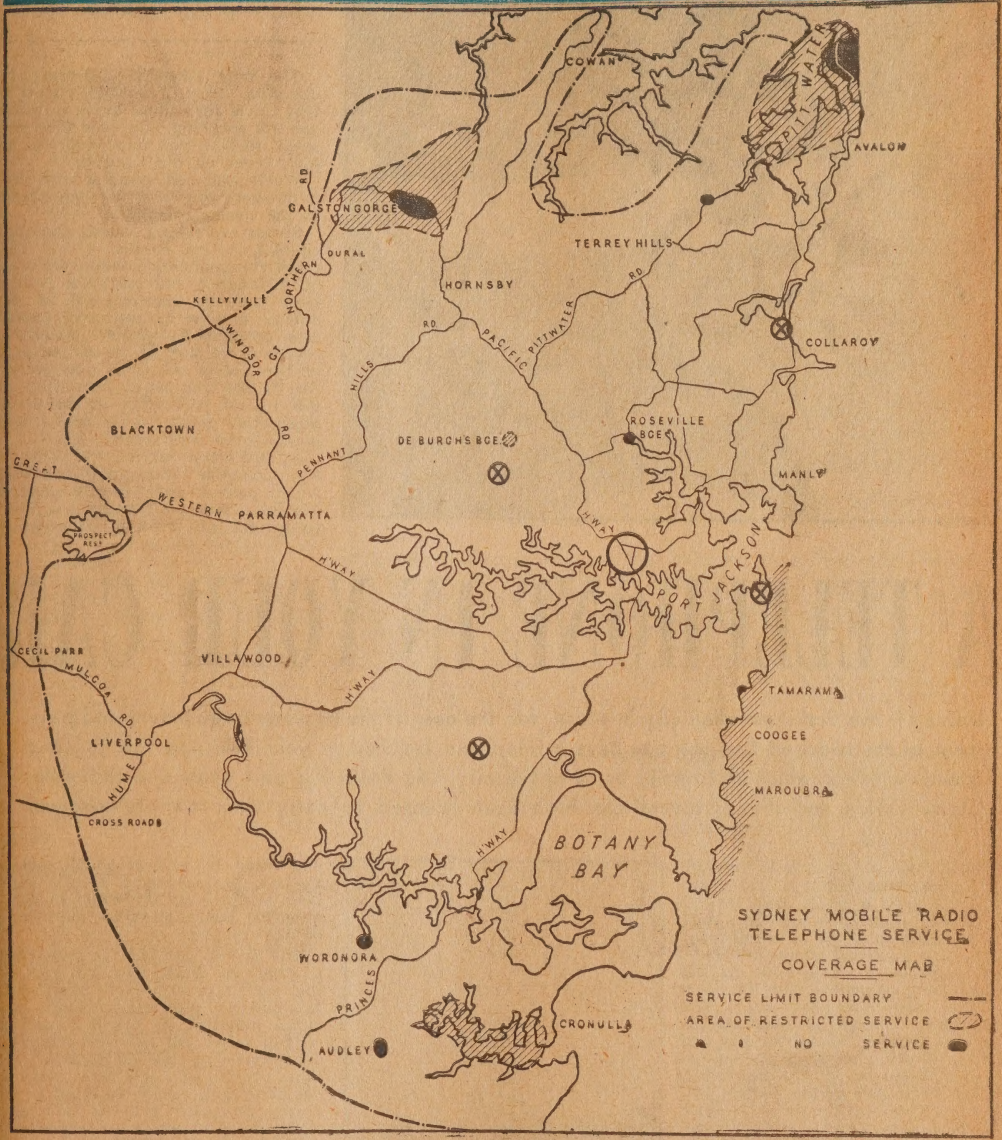
RADIOPHONE COVERS METROPOLIS



THIS map is supplied to all users of the new radiophone service so that they will know when they are within range of the main transmitter. On it we have marked the position of the transmitter at North Sydney, and also of the remote receiving positions at Collaroy, South Head, Bexley and Ryde. The "dash-dot" line shows the approximate limits within which you should be able to place and receive calls with about the same clarity as through the normal telephone. The shaded area indicates that there may be low-lying spots from which contact might be difficult or impossible. The black areas correspond with very badly shielded places from which the radio waves from the car will almost certainly not be heard by any of the receivers.

Experience has shown that, provided your car is on a high spot within virtual visual range of North Sydney, calls may be placed well beyond the service area. For instance there will be many places along the Blue Mountains Road, even as far as Mount Victoria, from which good results will be obtained, but it would be unwise to include them within a specified coverage limit. Some technical knowledge would be necessary to "pick your spot" under these conditions, and for that reason, the average user should not expect more than the PMG engineers have indicated on the above map.

The telephone operates just like a normal handset except that a "Press to Talk" lever is squeezed by the fingers when speaking—released when listening. Handset clips into place on small control panel, when not in use.

The only essential difference in operation from a normal phone is that Uncle Joe cannot break in while you are speaking, and each time you speak to him, you must depress the little lever on the handset.

When your conversation with him is finished, you hang up your phone in the normal manner.

So far everything sounds absurdly simple, and so in fact it is. The radio communication engineers who have designed and built the system have done an excellent job of reducing a most complicated matter into ordinary telephone procedure, requiring no skill at all on the part of the operators, or of you either. But before you make your way to the nearest post office in search of application forms, there are a few points to be considered.

In the first place, one doesn't buy complete transmitter-receivers which possess such simply-operated control systems for nothing. Your equipment will have to be supplied

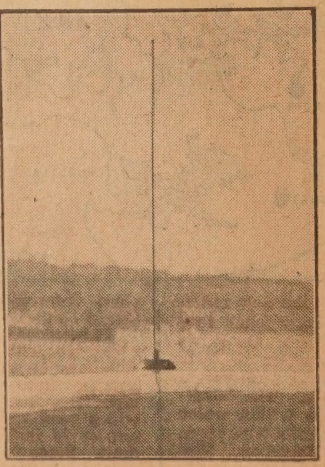
A TELEPHONE IN YOUR CAR

Sydney is the first Australian city in which, for the cost of the necessary equipment and payment of the required fee, you can have a telephone installed in your car, and talk to your friends within a radius of 20 miles or so of the city. The PMG has now opened a radiotelephone service, and already several cars have been licensed to carry their own telephones.

THIS apparent miracle is brought about by having installed in the car boot a small radio transmitting and receiving station which, in conjunction with a small roof aerial and a normal telephone handset, provides a radio link to the telephone exchange to take the place of the wires normally used. The telephone handset is mounted in some convenient manner (determined by the people who made the equipment you bought) on the dashboard. When Uncle Joe wishes to tell you that you have left the picnic hamper behind in your hurry to depart on a car trip, he picks up his phone at home, asks for B0707, gives your car numbers, and hangs on.

You, bowling along the highway with your radiophone switched on, suddenly hear a bell ring behind the dash. If you can drive with one hand, you pick up your handset in the car, press a "talk" lever in the handle with your finger, and answer in the normal manner.

A few seconds later, you are talking to Uncle Joe and, in all probability, preparing to return for the missing viands.



A small vertical aerial mounted on the car roof accommodates both sending and receiving. It is about 18 inches long and may be flexible metal rod.

and fitted by a firm which makes such things, and whose designs have been accepted by the PMG as suitable for operation with their part of the system.

The cost to you will be from £200 to £300, for which you will receive the transmitter-receiver fitted into the boot of your car, a short, rod aerial mounted on the roof, and a control panel and hand-set mounted somewhere on the dashboard. In other words, you will now carry a complete radio station adjusted to the correct frequency of about 160 megacycles, and for which a licence will be issued by the PMG.

This licence and rental will cost you £51 per year, and each call you make will cost you 6d. Your callers, too, will be charged 6d each time they ring you up.

This high charge isn't there to discourage you, or to make huge sums of money for the PMG. As we shall presently show, the cost to them of installing their part of the works is considerable, and requires highly trained technicians for its construction and maintenance.

It is possible to install a receiver

only in your car, which will allow messages to be passed to you on the road, but to which you cannot reply. This system is much cheaper for you to install and costs only about £20 per year. Its use is rather limited, however, and it is doubtful whether many will find it worthwhile.

Subscribers to the system can be pretty certain of obtaining an excellent service from their radiophones. At the invitation of the Department, we were able to inspect the complete installation soon after it was officially opened, and to make a test run in a car fitted with a standard radiotelephone made by a Sydney manufacturer.

TEST RUN

During the run, which embraced quite a large section of the service area, no trouble was experienced in making or receiving calls from the car. The standard of the service, and the clarity of the voices, was approximately the same as that obtained from the ordinary telephone in the home. It makes little difference whether the car is stationary or in motion, although the mechanical noises when the car is moving do make it a little harder to hear, as is only to be expected.

The apparatus is powered from the car battery, and may require up to 40 amps when transmitting—5 or 6 amps during "standby."

This is a high battery drain, and may call for extra batteries or other modification to the car's electrical system.

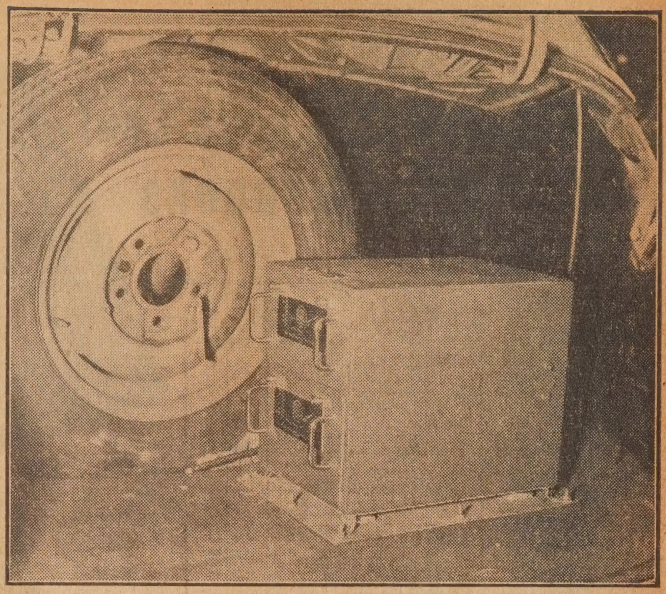
On page three appears a map showing the service area of the telephone, and the location of the transmitting and receiving aerials operated by the PMG. From our experience with mobile radio, we would say that this map presents the service area quite accurately, with the strong probability that in many cases it will substantially be exceeded when the car itself is on high ground.

MAIN AERIAL

The first technical problem faced by the PMG engineers was how to get a strong signal into your car anywhere in the service area, bearing in mind that radio waves at such high frequencies travel much like light waves, and are not good at diving down deep cuttings or behind steep hills. The problem was solved by first of all using a fairly high-powered transmitter which radiates 250 watts of power, and feeding it to a very high aerial.

The aerial is, in fact, mounted on top of the FM aerial tower which most people have seen at North Sydney, and from which visual range or near it can be had to almost any spot within the city and suburbs.

This aerial is so made that it shoots the signals close to the ground in all directions, and very little up in the air. Actually the aerial is known as a "double discone" and the flattening out of its radiation bumps up the available power by 4 decibels, quite a useful increase over a plain aerial. As this gain just about balances out the loss in the cable which runs down to the transmitter, the full capability of the transmitter is made use of.

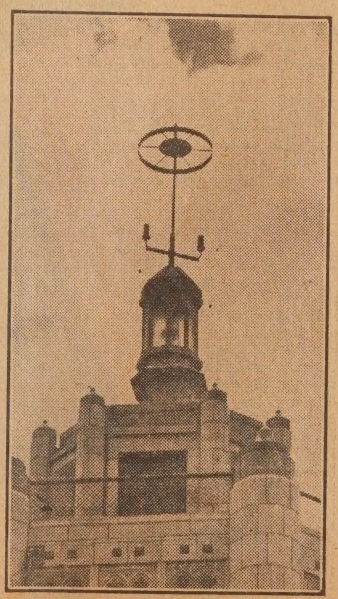


Several commercially made transmitter-receivers are available approved by the PMG. This one is quite small but complete.

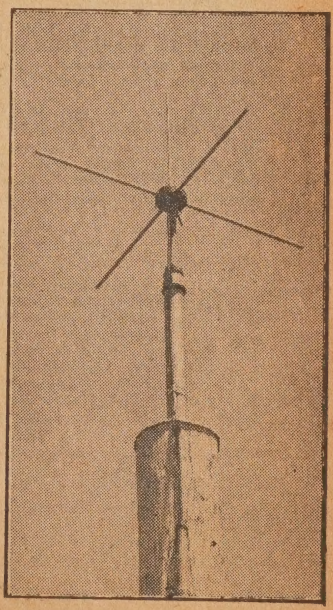
The control circuits to the transmitter run through wires to a telephone switch-board so that it can be remotely operated by the switchboard operator. She, of course, need know nothing of radio, because the whole intricate mass of wires and relays are quite automatic, just as they are in normal telephone technique.

It is more difficult to provide clear, strong signals back from the cars, because their transmitters are powered with only about 25 watts, and their aerials are close to the ground, often in low-lying spots some distance from the transmitter.

The receivers which send signals



Many have already noted the receiving aerial on the Grace Building tower, Sydney, one of the city's highest points.



A standard "ground plane" aerial is mounted on a tall pole or high structure at remote receiving points.

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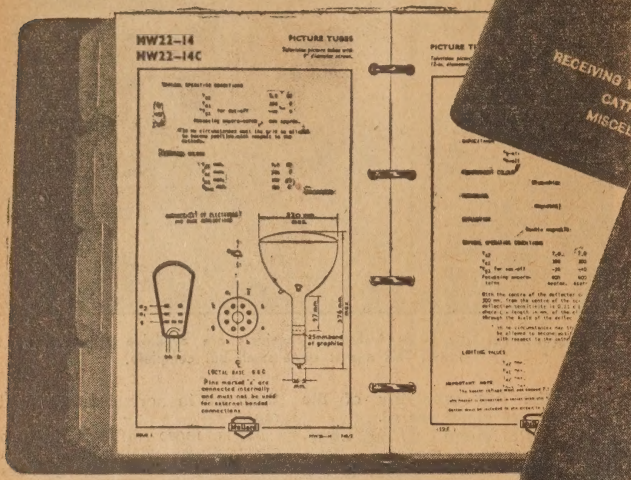
VALVE DATA HANDBOOKS



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back to the exchange, therefore, are placed round the various suburbs in the highest possible places, each with its own aerial on top of a pole, or a high and convenient structure, such as a water tower. Careful placement of these means that no matter where your car may be at the time, it is always within good operating distance of one or other of these aerials.

Wires connect each remote receiver with the exchange, and these not only send signals back to the operator, but allow the receivers to be turned on and off. They are locked up in weatherproof cases, and are unattended except for regular maintenance.

An automatic muting or "squelch" circuit keeps the receivers quiet until someone in a car makes a call. Then all the receivers capable of hearing the car feed its signal back to the switch-board.

RECEIVING

When this happens, signals from more than one receiver may be fed back to the exchange, but, normally, only the receiver which comes into operation first is connected to the line. Receivers which can pick up only a weak signal from the car do not come into operation at all. In other words, either a strong, useful signal is heard, or none at all. There is no point in charging people 1d for a call when the car concerned is too far away to be properly heard. That is why the PMG issue each car with a copy of our page 3 map, so they may know the limits beyond which they may not be able to place a call.

The method by which only the wanted car is called by the exchange may take one of two forms, according to the type of equipment you have bought. The exchange is so arranged that it will work either system.

One of these, which is almost universal in America, is operated by vibrating metal reeds in the receiver, which respond only to sounds of a certain pitch. When the car is to be called, these sounds are first of all sent out over the big transmitter. As only one car answers to any one combination of sounds, its bell is the only one which rings when that call is made. The telephone operator does all this automatically when she dials the car number at the exchange. The rest is up to the equipment itself, and the ingenuity of the men who designed it.

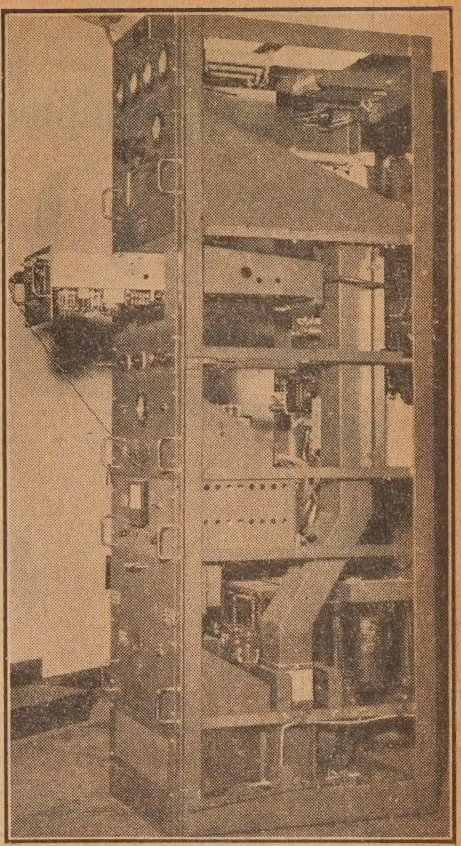
Because only one frequency or wavelength is at present available for all this, there is a limit to the number of cars which can be connected, for you cannot make your call while others are talking. The number of cars which can be accommodated will depend on how much they use their phones. When "engaged" periods become too frequent, the only remedy is to install a new "base" transmitter on a second frequency, which is the equivalent of laying extra wires to an overloaded phone system.

The PMG expects to have radiophones installed in the capital cities and Canberra, and some of these are already partly fitted. At the moment there are no plans for extending the service elsewhere, and because of the cost and emergency value of the idea, it is unlikely that extensions will be warranted. Those who have a use for the system, however, will undoubtedly find it an invaluable addition to the growing service provided by the department.

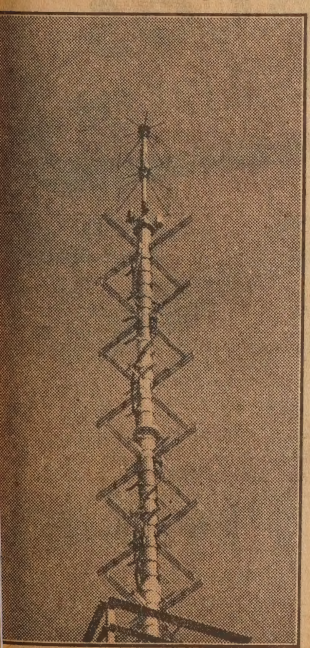
In passing, it is interesting to compare the charges of the Sydney mobile radiophone with those in America. In that country, the cost of a three-minute general service message is about three shillings, depending on the location of the land-line in the mobile service area. On long distance calls the regular person-to-person day rate applies with a minimum charge of about three and sixpence.

The equipment in the car may be supplied either by the user, or by the telephone company, remembering that in USA the telephones are operated by commercial concerns. If the company supplies the equipment, the rental is £5/10/- per month for two-way service, plus £8 installation charge—total £74 for the first year. There is also a minimum monthly message rate of £3 per month.

A point which may be stressed concerning the radiotelephone is that conversations may be picked up by anyone having a suitable receiver, and are therefore not private. Subscribers should therefore be very careful not to say anything which will not bear repeating by others, or which are of an embarrasingly private nature. It in some comfort, however, to know that ordinary radio sets could not hear the conversations, and only confirmed stickybeaks would bother to provide themselves with special sets to listen in!



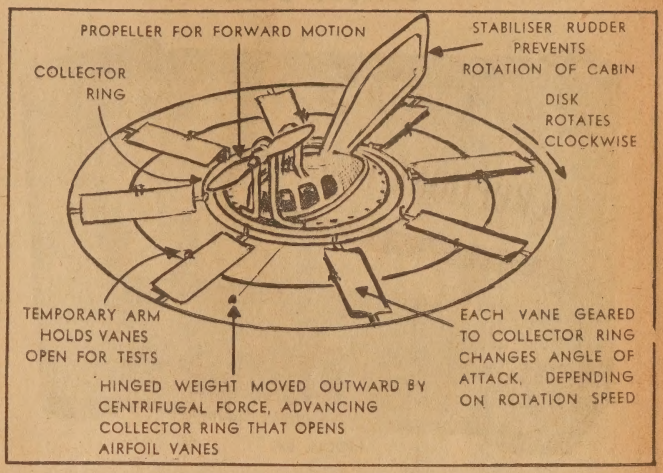
The main transmitter at North Sydney with the exciter unit partly removed. Final power stage is immediately above with an output power rating of 250 watts.



Excellent coverage of main transmitter to cars is ensured by the use of an aerial on top of the FM array at North Sydney—probably the highest point near the city.

WILL A SAUCER REALLY FLY?

Flying Saucers!—we first heard of them more than a year ago speeding through Amercian skies at great speeds. Soon everyone was seeing them in all parts of the world. Some were reported as having actually crashed to the earth, complete with the remains of men from another planet! Many people now believe that there never were any saucers, Others are not so sure, and are convinced that optical illusions and auto-suggestion don't explain away the facts.



Sketch of the 41 inch model saucer built by Dr. Kay, showing essential points of design.

ALTHOUGH we have not seen evidence more concrete than some rather indistinct photographs of an alleged "saucer," there is no essential barrier to the construction of an aircraft which would look like a saucer, and fly at high speeds. It is doubtful whether saucers have actually been seen in all the places from which reports have been received, but it is perfectly possible that at least some accounts are authentic, and that the objects were in fact experimental models of a new aircraft revolutionary, by all conventional standards.

As a matter of fact, there are a number of Australian patents in existence for flying saucer aircraft, although it is not known whether any successful models have been built. How many others could be found elsewhere is not known, but there must be thousands.

One type which has provided successful model flights has been developed by Dr. E. W. Kay, of Glendale, California, whose approach seems to be quite sound.

He has made a 41in model consisting of an aluminium-magnesium rim built round a central cabin. The rim is spun at 400 rpm by an electric motor through a ring gear. The motor also drives a conventional propeller for forward speed.

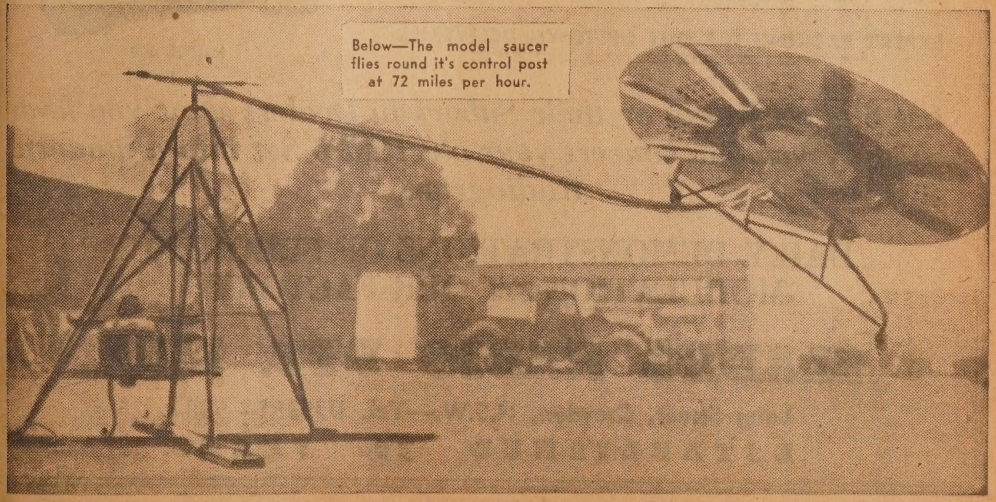
Lift is provided by vanes situated radially in the disc, which thus resembles a huge fan. These vanes are adjustable to give varying degrees of lift.

Although the model requires a short take-off run, Dr. Kay believes that a full-sized model, up to 50ft in diameter, could rise more or less vertically, and fly forward at 400 mph. The cabin, of course, would not rotate, and the whole job would be jet powered.

His model, anchored to an 18ft arm, flies round an anchored post at speeds up to 72 mph.

Enormous lift should be possible from a full-scale aircraft, and extreme flexibility likely by appropriate design of the vanes, and their variable angle of attack.

The inventor hopes to build an 18ft flying model which would carry a man, and is confident that his idea, which combines the design principles of both the aeroplane and the helicopter, will provide the answer to the search for a highly manoeuvrable, fast aircraft.



Below—The model saucer flies round it's control post at 72 miles per hour.

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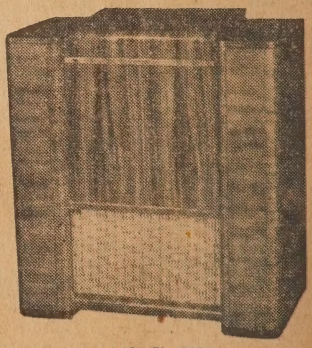

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BRITAIN'S HELICOPTER AIR BUSES

British helicopter experts are making plans for inter-city air buses in five years, according to our London correspondent. Their activity foreshadows inevitable development of short haul air traffic which can cope with restricted landing spaces.

The Westland-Sikorsky S51 helicopter.

THE world's first regular passenger service by helicopter began recently between Liverpool and Cardiff—a major step forward in plans for air-buses travelling between city centres.

The service is conducted by British European Airways.

The first day's flights were booked out, the rush being due to the novelty, needless to say. But helicopter passenger services will not be a novelty long, according to BEA experts.

Big intercity air buses, they believe, may be the regular thing within five years.

Mr. Peter Masefield, chief executive of BEA, has in mind multi-seater helicopters carrying about 30 passengers each. The Westland-Sikorsky S51 helicopters to be used on the Liverpool-Cardiff service carry only three.

But they will be "flying guinea-pigs" which will provide a valuable opportunity for working out traffic-handling problems and operational technique which the helicopter mail service—in use for some time—has not supplied.

PASSENGER SERVICES

And at the same time they will be getting people used to the idea of helicopter travel.

At first sight it would seem that the proposed use of an airfield more than six miles out of the city at Liverpool (it is about two at Cardiff) almost defeats the helicopters' advantages.

But BEA are unwilling to bring the single-engined helicopter into built-up areas even if rotor stations (the name they are giving here to helicopter landing grounds) were available.

If the helicopter proves popular with passengers, however, development of helicopter services on plans already well in hand will go ahead by leaps and bounds.

The mail service has already satisfied all safety requirements, and showed that the helicopter can do the job—and in nearly all weathers.

After experiments in the west of England, which eventually took the form of running a dummy mail service early in 1948, a regular daylight mail run by helicopter was begun in June of that year. It was a 215-miles circuit from Peterborough around the Norfolk coast, covering the Broads, or inland waterways, of that county—an area in which the helicopter showed up to particular advantage.

The winter brought that service to a close until further experimental work was carried out and special equipment evolved for night and blind flying to schedule.

Last year a further test with dummy mail, carried at night this time, satisfied the Post Office, and a regular mail service at night was taken up by the helicopter between Peterborough and Norwich last October. It has gone through every night so far—and where the helicopters have been delayed it has generally been by weather which has upset land services too.

by Ken Murchison

The new Liverpool-Cardiff passenger service is regarded as another stage in this series of experiments with helicopters. It will be operated twice a day each way, taking about 1¾ hours to cover the 140 miles distance between the two cities.

Wing-Commander R. Brie is in charge of BEA's helicopter experimental unit and he has already picked four pilots to start off the Liverpool-Cardiff service.

What of the future? Several firms are making helicopters and planning new designs—including a super 36-seater in one case. But the industry cannot tool up for big production unless it can anticipate an equal demand. Meanwhile operational regulations for helicopter services—which will now have to deal with the problem of city landing stations—are under review.

With the possibility of intercity travel in these air buses of the future coming nearer much may depend on how the first regular helicopter passenger service "catches on."

TWENTY YEARS FROM NOW

Up to the moment the only tangible result of the great scientific achievement of atomic fission has been entirely destructive. "Splitting the atom" has resulted in the deaths of thousands, in scaring hundreds of millions and in making the nations of the world suspicious of each other—not very creditable results for one of the greatest scientific triumphs of all time.

(Continued from last month)

by Professor A. M. Low

BUT I think that when we look back in 20 years time we may see the use of the atom-bomb just as an incident in the history of atomic energy. Without being cynical, we may take the view that the explosion at Hiroshima was like an explosion in a high-explosive works or a child cutting itself when learning to use a knife.

For in 20 years time I believe that atomic energy will be "harnessed" and supplying us with millions of horsepower of energy a year. I do not rule out the possibility of it being used as a military explosive, but fully developed atomic energy could bring about an industrial revolution hardly less important than the harnessing of steam power.

RESEARCH WORK

Britain is spending large sums simply on preliminary steps in research on atomic fission for "peaceful" purposes, and other nations are also spending vast sums. In 20 years we shall have the fruit of this research. In the House of Commons, Ministers have been at some pains to damp down the idea that atomic power could lead to the Utopia of a four-hour working day, but the reasons for this are probably psychological.

Of course, there are immense technical difficulties—that is why we are spending millions. But if the result of overcoming these difficulties is not to be a supply of abundant, cheap power, why trouble to tackle them?

The principle by which it is assumed that atomic energy will be harnessed is that atomic piles will be made to run so that they heat water, which in turn will drive gas or steam turbines. Research may show that there are more direct methods by which the energy can be harnessed, just as it is likely to reveal methods of utilising the atomic energy of elements less expensive than uranium, which has hitherto been used.

DISADVANTAGES

In the light of our present knowledge, the disadvantages of atomic power are: The very high cost of the plant and "fuel"; the fact that an atomic pile must be large; and, thirdly, the poisonous gases and by-products of atomic fission which have to be disposed of.

The last two disadvantages are taken to mean that it will never be possible to utilise atomic power for transport — the energy generator would be too large except, perhaps, for a ship, and the impossibility of disposing of the dangerous by-products would make it impossible to use atomic power in street vehicles or even trains.

But it would be wrong to assume that this disadvantage will always exist. Just as we may find cheaper atomic "fuel," so we may find methods of utilising atomic energy indirectly, turning it into a synthetic fuel that could be used by comparatively small power units and with no danger from by-products. You will not, in 20 years, stop at a garage and fill up your car with uranium—radioactive materials are too dangerous to use in densely populated places even when they are in "foolproof" containers. But you may fill up with a fuel whose potential energy has been derived from an atomic power generator.

FIRST USE

The first practical use of controlled atomic power, paradoxical as this may sound, is likely to be in countries which are not greatly industrialised. With our present methods atomic power is rather more expensive than power derived from coal. Research will undoubtedly bring down the cost so that atomic power becomes much cheaper than power from coal.

But the fundamental fact remains that, in this generation of electricity and the manufacture of goods, the cost of power is only one item. Fuel accounts only for about 40 per cent of the cost of our electricity—as against 60 per cent for distribution and administration. In many manufactures the expenditure on fuel represents only about 10 per cent of the total cost.

It will be seen, therefore, that even if we could get atomic power for nothing, it would not make such an enormous difference. The importance of atomic energy, in my view, lies in the fact that we can look forward to obtaining it in quantities inconceivable for coal or oil derived power, and that the fuel is comparatively light and easily transported.

This means that we shall undertake gigantic engineering feats that would be impossible with our present sources of power, and that we shall be able to obtain power cheaply in places remote from present industrial centres.

For instance, with atomic power it is possible to consider great irrigation pumping plants in the heart of deserts, where the cost of transporting fuel would at the moment make the use of power pumps quite uneconomic. In the arid regions of Australia and Africa there is water if the boring is deep. Atomic power offers the possibility of getting it.

GIGANTIC ENGINEERING

We shall be able to contemplate gigantic engineering feats which may change the climate and even the weather. Twenty years ago the idea of removing—or making—mountains in order to change the rainfall seemed ridiculous. Using the power of atomic fission it becomes a practical possibility. We can contemplate melting Polar ice or warming the soil over hundreds of square miles.

The Americans have already talked, even if only half seriously, of diverting the Gulf Stream so that it gave them more warmth. That may become a real possibility. It is in such ways, perhaps, rather than in replacing coal and oil as fuels, that atomic power will be used.

Atomic power may prove to be the key to inter-planetary flight of which I have written in my first article. A few tons of atomic "fuel" will provide more energy than thousands of tons of oil. We may even discover methods of renewing the fuel by making use of the atomic fragments —cosmic rays—which we know are abundant in space.

DANGER

The difficulties of the dangerous radiation will, I believe, be overcome more quickly than anticipated, and the present tremendous concrete walls may seem as clumsy as mediaeval armor in 20 years. It is worth noting that in the short history of atomic energy the experts have constantly had to revise their ideas of the future.

After Hiroshima they were at pains to say we could expect no peaceful developments for 20 years. Then they began to talk about 10 years. Now they admit that the first "pilot" commercial atomic piles are ready

(Continued on Page 63)

Careful study of prints reveals essential characteristics which go to the building up of individual prints.

YOUR PRINTS ARE PERMANENT

There is something sinister in the phrase "He had his fingerprints taken", yet today the use of fingerprints goes far beyond the tracking down of criminals. It is true that most of the publicity regarding fingerprinting has been devoted to its use in criminal investigation and many fantastic stories have been woven around this branch of science.

PERHAPS this is due to the fact that there is nothing sensational in a person stamping his finger prints on a legal document or as a means of identification when he deposits his money (if any) in a bank.

There is an exciting lure for the impressionable in a detective carefully blowing powder on the glass supposed to have been used by the poisoner, in order to bring out the prints. There is breathless sensation in the action of the great sleuth who, regardless of the scorn of the regular police force, manages to find the convicting print on the rough edge of a two shilling piece.

DACTYLOGRAPHY

But what is exciting about a man stamping his finger on a cheque or a mortgage? Nothing to make a song about. Yet this practice is increasing from day to day.

The science of Dactylography as the science under discussion is called has great value in many places where identification of individuals is called for.

Some of these are the identification of dead bodies, registration of aliens, passports, circular letters of credit, and the identification of infants particularly the newly born where the mixing of babies can cause much trouble and litigation.

Banking functions and legal documents have already been mentioned. The identification of lost children and people suffering from loss of memory is aided by fingerprinting.

The defence forces of the United States have millions of fingerprints of Service men and women in their files.

One of the instances often cited in defence of the infallibility of the fingerprint system is in connection with the payment of the Veterans of World War I bonus.

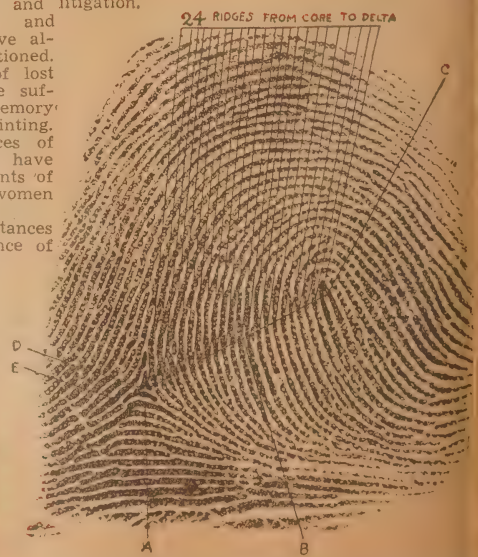
Over 3 million ex-servicemen of the USA were obliged to impress the fingerprint from the finger of one hand on their application form.

It was this print which furnished the evidence that the person receiving the payment was identical with the person who served in the forces over 20 years previously and whose record was in the files of the Army.

IDENTIFICATION

These finger prints also have been the means of identifying the bodies of soldiers, sailors and airmen who have been found dead in civilian clothes.

The litigation which has recently taken place in Australia regarding the alleged mixing of two babies at a maternity hospital may have been avoided had that hospital adopted a method of palm or foot printing



This is an Ulnar outer loop having twenty four ridges on the line of count. A—Lower type line. B—Line of count, the shortest possible line from Core to Delta. C—Core. D—Delta. E—Upper type line.

The use of finger prints for identification seems to have been used first by the Chinese. These people used it mainly for legal work.

In early England the thumb print was used by persons who could not write their signature.

Even today a thumbprint on the end of a letter would be of more use than some of the signatures one strikes now and again. It would be a great help to a business firm if some of their correspondents sent their fingerprint together with their alleged signature for filing away so that further letters from the same person could be identified.

It is now a firmly fixed belief that it is absolutely impossible for any two persons' fingerprints to be alike. It is also accepted that a person's fingerprints do not change during the lifetime of the individual.

The skin of the human body consists of two main layers called the dermis or true skin and the epidermis or surface layer.

THE DERMIS

The Dermis is the under layer of skin and has nothing much to do with our subject. The Epidermis however, has peculiar characteristics and with it we will have to deal.

The skin, aside from being a protective covering for the flesh, acts as a temperature regulator and vehicle for the expulsion of waste products from the body.

If a piece of skin is examined under the microscope it will be found to be permeated with large numbers of very fine holes or pores. These are really outlets from tiny glands situated in the deeper layers. These glands are of two kinds—"sebaceous" and "sweat" glands which secrete an oily substance, and sweat (or perspiration) respectively.

A peculiar thing about sebaceous glands is that they are found over the entire body except on the palms of the hands or the soles of the feet.

Sweat glands are found over every part of the body.

HANDS AND FEET

The palms of the hands are called the "thenar" surface and the soles of the feet are called the "planter" surfaces.

On these surfaces there is a very peculiar formation of the skin. It is marked with a mass of very fine ridges showing a definite formation or pattern. These ridges are called "papillary" ridges and form the basis of finger print science.

The papillary ridges are formed by small elevations on the under or true skin and it is along these ridges that the pores are arranged in regular rows along the crests of the ridges.

On no other part of the body are these ridges found.

The patterns formed by the papillary ridges remain unchanged throughout the entire life of the individual except when destroyed by accident, and they remain unchanged in every minute detail except that the pattern grows larger as the individual grows. This is natural and reminds one of the story of the man whose wife had previously been the tattooed lady in a circus. She now has a battleship tattooed on her chest. When he first met her it was only a rowing boat. It is remarkable how far the human skin will stretch without bursting. But this has nothing to do with our subject so let us get on.

A. B. C. D. E. F.

A—A plain arch. B—A tented arch. C—An exceptional arch. D—A radial loop. E—An ulnar loop. F—A central pocket loop.

This pattern is known as a whorl.

These papillary ridges are so unchanging that they persist even after death until the body has reached a very advanced state of decomposition.

When the outside layer of skin is injured it will heal and show the identical ridges as before, unless the under layer of skin has been injured, thus destroying the papillae which form the ridges on the epidermis. A scar will be formed under such conditions and the ridges do not form on scar tissue.

EFFECT OF INJURY

Sometimes a severe injury will cause distortion of the tissue surrounding the scar, thus rendering comparison of present with previous fingerprints a difficult matter. Needless to say many criminals have resorted to self injury in order to conceal their fingerprints. For this reason prints of criminals are now taken of the entire two hands and sometimes of the soles of the feet. A man would have a job to injure both hands and feet.

The science of dactylography is based on the formation of these papillary ridges. These, to repeat, form certain patterns which have been classified over the years. They fall into well defined groups owing to their geometrical formations.

The patterns are divided into simple patterns and composite patterns. There are certain cardinal points or determining points on a

Left—The core, indicated by the dot at the apex of the inside ridge of the loop. Centre—Type lines, indicated by the blackened curves at right centre. Right—The delta.

ngerprint by means of which the nvestigator determines the exact attern he is studying. The ridges etween these cardinal points are nen counted, classified and filed.

As mentioned previously finger rints consist of a series of ridges. hese are produced by first coating ne fingers with printers ink and ressing or rolling the fingers on a neet of paper. The prints show as series of black and white lines.

CARDINAL POINTS

The cardinal points are of the tmost importance in the classifictions of finger prints and those hose business it is to study prints nust be able to recognise them inantly.

These cardinal points are the Core nd the Delta.

The Core is shown in the accomanying figure. It is the heart of simple pattern and is situated nside the point where the inside idge curves back upon itself.

The Delta is shown in the next iagram. It is called a delta beause of its triangular structure and ccurs at the point where the ridges n their sweep across the finger, eparate and enclose the main patnr.

There is another cardinal point hich may be of great significance n classifying complex patterns. his is the "type line" and consists f parallel lines or curves which ow upward and inward to a point here they diverge and form the elta. These are shown in another iagram.

Finger prints are divided into atterns. These consist of arches, oops, whorls and accidentals. There are again subdivided into ctions as follows:

RCHES

PLAIN ARCH. This is shown in e diagram. It consists of ridges hich flow from one side of the int to another, perhaps rising ightly in the centre.

TENTED ARCH. Here the ridges w from one side to the other, but se abruptly in the centre giving a nt-like formation.

EXCEPTIONAL ARCH. This is nilar to the plain arch except that has one ridge which recurves. his is located at the centre.

OOPS

RADIAL LOOP. A loop where e ridges turn back and slope ownward toward the little finger.

ULNAR LOOP. A loop where the ges turn back and slope downard toward the thumb.

WHORLS. A pattern where the ges form complete circles which ve the pattern the appearance of a whirlpool.

CENTRAL POCKET LOOP. This is similar to a whorl except that one or two lines or ridges break and turn back at a point in the diameter of the whorl.

TWINED LOOPS. Two loops side by side in which the ridges curve in opposite directions.

LATERAL POCKET LOOP. Two loops side by side but with the ridges turning back and coming out on the same side.

ACCIDENTALS. Irregular patterns which cannot be classified with any of the others. They are really two or more types in a single print.

All these classifications of finger prints are illustrated in the various diagrams which make the matter quite clear.

Left—A twin loop. Centre—A lateral pocket loop. Right—An accidental.

Among all these one finds fingerprints whose types correspond, but whose variations are so distinct as to make them recognisable to the expert.

Types of fingerprints are subdivided by ridge counting or ridge tracing. The former method is used when examining a loop type of print while the latter is used in examining whorls.

The method of counting is fairly simple. An imaginary line is drawn from the core of a loop to the delta, then, by means of a fine pointer the number of ridges between these two cardinal points are counted.

GROUPINGS

It has been found that the number of lines on the fingers fall into well defined groups. There are what are called balance lines which are given numbers.

For instance the balance line on index fingers is the ninth line. This means that there are just as many fingers which have nine lines from the core to the delta as there are fingers which exceed nine.

The balance line on middle fingers is the tenth line. This leads to a further classification of loops into two classes. The loop on an index finger is called an inner loop when the number of ridges between the core and delta count nine or less. When the number of ridges count ten or more it is called an outer loop.

When it is a middle finger loop it is an inner loop when the ridges count ten or less, and an outer loop when the count reveals eleven or more ridges.

Whorls are similarly subdivided into inner and outer whorls. These are determined from the number of ridges between the two deltas.

Out of all the whorls, loops, arches, deltas and accidentals the finger print expert is able to classify the print, give it a formula and file it away for future reference when needed.

It will be seen that the classification of a finger print is a most important item. By means of this classification which falls within ten general types as outlined above the print can be subsequently identified by further subdivision by ridge counting and tracing.

The grouping of sets of prints so that it may be identified out of thousands and sometimes millions of prints is a complex matter, but today it is so highly organised that no person who commits a felony and whose fingerprints have been previously recorded in the files of the Police Dept. can fail to be identified by a print he has inadvertently left behind at the scene of his crime.

To attempt to describe the methods by which fingerprints are grouped and filed is quite beyond the scope of this article.

It is, however, so interesting that those whose interest may have been aroused by the discussion would do well to study the method through a recognised text book.

The finger print system is so expanding in its usefulness that it holds something as a career for those who make themselves expert at it.

For those who wish to take their own fingerprints to compare with the illustrations given, the method used is as follows.

MATERIALS

The materials required are a small tube of printers black ink, a small rubber roller, a sheet of glass and some white smooth paper. Place a small quantity of ink on the glass, roll out well with the roller to get a very thin film of ink. Place one edge of the finger on the glass and roll the finger over to the other edge, lightly pressing while doing so.

Now place the finger on edge on the white paper (which should be placed on a hard surface) and roll over to the other edge. This will leave a good print. The finger should be well cleaned before applying the ink. The ink can be washed off afterwards with petrol or kerosene.

Finger print examination is an interesting hobby and can provide endless amusement.

Technical Review

FURTHER DETAILS OF THE "VIDICON" CAMERA TUBE

The miniature RCA "Vidicon" tube featured last month, uses a very old but a basically different principle from other current types. The story is told by three RCA workers in a recent issue of "Electronics."

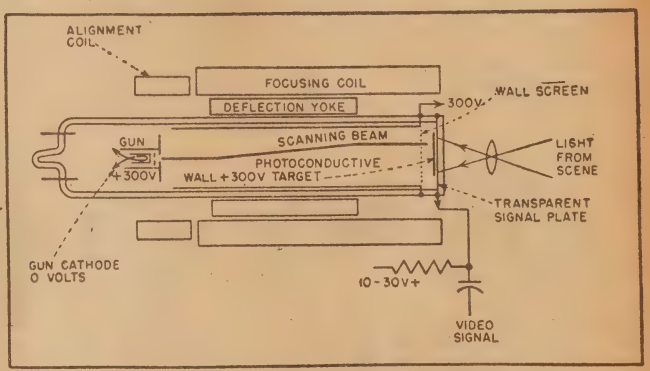


Figure 1. Cross-sectional diagram of an experimental Vidicon photo-conductive television camera pickup tube.

MOST camera tubes, to date, operate on the principle of photo-emission. In other words, the light rays are focused on a sensitised surface which emits electrons according to the strength of the impinging light. The electrons are utilised in a variety of ways, according to the tube design, but ultimately operate on the output circuit of the tube.

An alternative approach, which was appreciated very early in the art, is represented by photo-conductivity, by which the incident light is made to vary the conducting qualities of the target.

MORE SENSITIVE

The significant point about this second principle is that it offers vast increase in photo-sensitivity, representing the difference between about 50 microamps per lumen for photo-emission to tens of thousands of microamps for photo-conductivity.

However, while many photo-conducting materials are known, there are practical difficulties in their application and, after considerable work on the principle in the middle 30's, it was again dropped in favor of photo-emission.

Intensive work on photo-emitters during the war, for infra-red detectors, threw much new light on the subject and encouraged RCA engineers to try again. It was realised that, if the principle could be applied successfully in practice, the higher sensitivity would obviate the need for multiplier stages and much of the complication surrounding the present Image Orthicon.

BIG POSSIBILITIES

Alternatively, it would be possible to obtain, with suitable amplification, a degree of sensitivity far exceeding that of the human eye and of the present Image Orthicon, complete with multipliers.

The word "Vidicon" has been coined to distinguish the general type of tube in the RCA range. The 1" model, featured last month, is largely an experimental release, but it shows interesting possibilities.

The circuitry surrounding the tube is more simple than for an Image Orthicon, while the control requirements are also less critical. It is, therefore, envisaged as an excellent tube for unattended industrial applications.

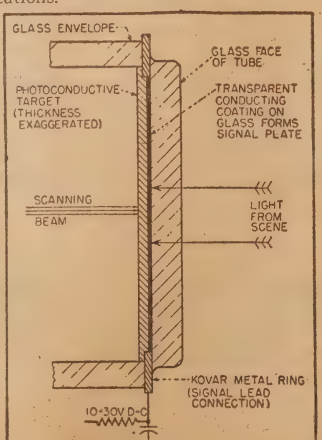


Figure 2. Detail of the target construction in the experimental photoconductive camera tube.

The one-inch Vidicon, with a target sensitivity of 300 uA. per lumen will transmit a noise-free picture using an f/2 lens and a level of light not exceeding that common in factories and laboratories.

Compared with an Image Orthicon tube, the Vidicon has a poorer signal-to-noise ratio at low light levels, it is much the same at medium levels and shows a better signal-to-noise ratio with high intensity of illumination. However, it tends to lose contrast under the latter conditions as compared with the Image Orthicon.

RCA yet has to build sufficient tubes to demonstrate whether the characteristics can be reproduced under commercial production conditions, while problems associated with temperature and tube life also await answer.

OPERATION

As indicated by figure 1, the operating principle is very simple. A magnetically controlled scanning beam passes first through a "wall screen" and then impinges on a transparent photo-conducting signal plate.

The side remote from the beam has a small positive potential applied and, with the light scene permanently focused on it, storage effects allow a volt or so to "leak" to the inner surface according to incident light values. This is discharged by the flying beam, providing the signal current from the signal plate.

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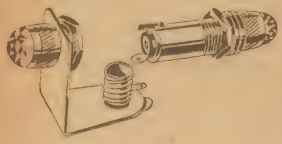

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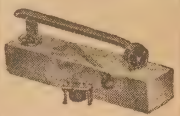

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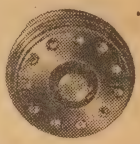

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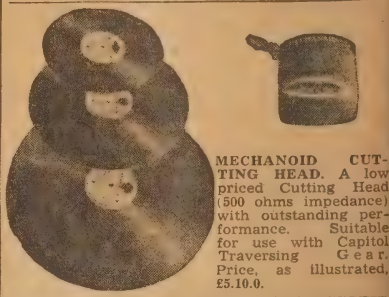

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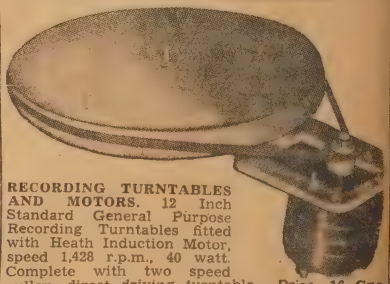

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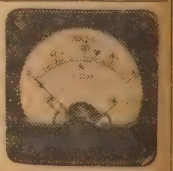

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RECORDS CUT WITH HOT STYLUS TIP

A new technique, evolved in the US by Columbia Records Inc., employs a hot stylus to engrave the sound track on lacquer-type master discs. A wide frequency range is obtained, together with low noise level, results comparing favorably with the best "wax" technique.

WRITING in Audio Engineering the author, W. S. Bachman, points out that lacquer-coated recording blanks are used very widely because of their obvious convenience. They can be handled and played back directly, if necessary, whereas wax-coated masters must be fully processed before any use can be made of the recording.

However, the problems of recording on lacquer type surfaces are quite different from those associated with wax masters.

It was appreciated immediately that stylii intended for wax masters gave a granular and noisy cut on a lacquer surface and special stylii have had to be developed. In general, these are distinguished by the provision of burnishing facets along the cutting edge, as illustrated. With such stylii, extremely quiet cuts are possible.

However, against this advantage, it was noted that the discs showed a marked loss of high frequency res-

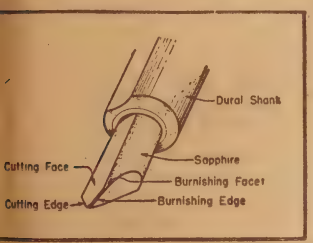

Fig. 1. Perspective view of lacquer cutting stylus.

onse, particularly on the inner rooves of 33 rpm records, where the roove velocity becomes small.

The effect was originally blamed the inertia of old-style pickup nd its effects on the softer recordng medium. While there was some stification for this, considerable ss was still evident with lighter, gh-compliance reproducers.

IMENSIONS

It was also suggested that a limit as being set by the relationship of e recording stylus dimension to the dius of curvature for high frency waves recorded with limit- groove speed. However, this uld be disproved by geometric anysis, provided that the amplitude kept below a certain critical fige.

Seeking another explanation for

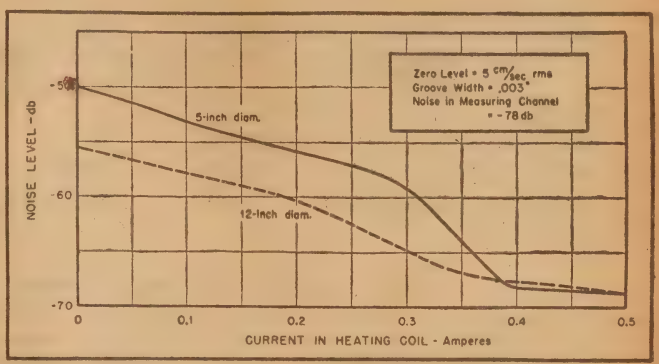

Fig. 2. Curve showing noise level in unmodulated groove vs. current in stylus heating coil. The noise is measured with a playback channel having uniform velocity response over a frequency band extending from 500 to 8000 cps.

the effect, an exhaustive series of cuts was made, using a variety of stylii, recording materials, frequencies and groove speeds. These indicated that stylii treated with facets did, indeed, show a marked high frequency loss, which was comparable with aperture losses in photographic recording or with the effects in magnetic recording of having the tape displaced from the magnetic head.

NOISE PROBLEM

Attention, therefore, turned to methods of combating noise, while retaining the type of stylus used for cutting wax masters.

The theory was advanced that the smooth cut on wax was partly the result of locally generated heat "flowing" the wax and smoothing the sides of the groove as it was cut. The effect could not take place in lacquer because of its high melting point and harder initial characteristics.

It seemed, therefore, that heat could be applied artificially to the stylus and allow it to have the same effect on the lacquer surface. Accordingly, a small heating coil was provided and further test cuts made. An immediate improvement was noted, indicating that the theory was well founded.

Figure 2 is a plot of the noise of a cut made with a sharp edge cutting stylus, with varying heat currents applied. The noise was measured on a velocity basis over a band extending from 500 to 8000 cps. The 500 cps limit was chosen to eliminate hum and rumble vibration from the measurement, and the 8000-cps upper limit was chosen to avoid response in the region where the dynamic mass of the reproducer at the stylus tip might resonate with the compliance of the groove which it engages.

Since these measurements were made on a velocity basis, it is evident that a further reduction in the measured noise would be obtained with roll off of the high frequencies, such as that used to equalise for pre-emphasis in recording. Even so, reductions of as much as 18 db in the background noise are readily effected, giving a resulting noise level 68 db below the NAB standard recorded programme level.

HEAT USED

The actual temperature attained by the stylus was not measured, but based on the resistance of the coil, the power supplied is in the order of one watt. With values of current in the order of 0.4 to 0.5 amperes, the heat is sufficient to give equivalent results in respect to noise and high frequency loss. Data obtained with heat of this order agrees very closely with curve E of Figure 5.

This development, which was undertaken in the laboratories of Columbia Records Inc., now makes possible the cutting of lacquer discs with very low background noise and a minimum of high-frequency response loss. All of the advantages which formerly were peculiar to wax are realised, without sacrificing the convenience and utility of lacquer discs for direct playback and processing.

HMV FREQUENCY RESPONSE RECORDS

ED1189 Side 1

50, 100, 250, 1000, 3000, 4000, 5000, 7000, 9000, 11,000, 13,000, 15,000, 17,000, 19,000 cycles.

Side 2

70, 160, 500, 2000, 3500, 4500, 6000, 8000, 10,000, 12,000, 14,000, 16,000, 18,000, 20,000 cycles.

ED1190 Same both sides

35, 50, 70, 100, 140, 250, 500, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10,000, 11,000 12,000, 13,000 cycles.

Graphs showing characteristics will be supplied with each record.

Each recording 9/- plus postage. Packing charge 1/6 for country and mail orders.

DECCA *ffrr* RECORDINGS

EURYANTHE OVERTURE – – – – – K 1154
AMARILLI – – – – – – – – – K 2070
(LA RONDE DES LUTINS / ZEPHYR OP 35) – – – – K 1799
LA SCALA DI SETS – – – – – – – K 2123
ADAGIO AND FUGUE IN C MINOR
Griller String Quartet – – – – – K 2224
THE WALTZ DREAM OVERTURE
THE CHOCOLATE SOLDIER—March – – K 2231
SWAN LAKE BALLET—National Symphony Orchestra – – – – – – AK 1308/
JOHN IRELAND SONATA IN D MINOR—
Frederick Crinke – – – – – – AK 14003/
HAYDEN SYMPHONY No. 88 in G MAJOR – – – – – – AK 1472/4
BRANDENBURG CONCERTO NO. 4 IN G—Boyd Neel – – – – – AK 1616/7
SYMPHONY NO. 5 IN D MINOR OP. 107 (Reformation) – – – – AK 1715/8

CONCERTO IN ONE MOVEMENT FOR VIOLIN AND ORCHESTRA – AK 1822/3
SLEEPING BEAUTY BALLET SUITE—
BBC Theatre Orchestra – – – AK 1524/5
MOTHER GOOSE SUITE — National Symphony Orchestra – – – – AK 1342/3
LA FOLIA (Variation Serieuses) – – AK 1670/1
ELIZALDE: CONCERTO FOR VIOLIN AND ORCHESTRA – – – – AK 1777/9
SCHEHERAZADE – – – – – – – AK 1966/7
MOZART SONATA IN G MAJOR — Eileen Joyce – – – – – – AK 1800/1
SCHEHERAZADE SYMPHONIC SUITE AK 1980/5
BRANDENBURG CONCERTO NO. 5 IN D MAJOR – – – – – – AK 1889/91
MENDELSSOHN: Concerto in E MINOR for Violin and orchestra—Alfredo Campoli AX290/2

Each recording 10/6 plus postage. Packing charge 1/6 for country and mail orders.

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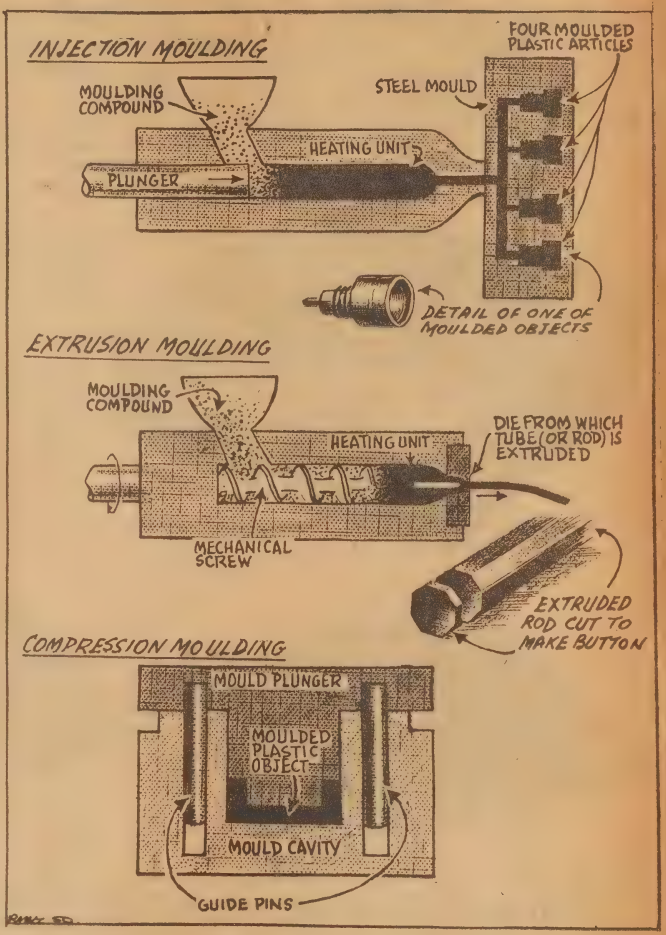
HOW IT WORKS—MAKING PLASTICS

This may be said to be the age of plastics, for during the 20th century industrial chemists have produced a whole range of new substances that are not only ultilitarian but attractive and they have replaced traditional substances in many fields. Still there is no sign of an end to the range and complexity of the new plastics.



NO longer is it necessary to use a natural substance such as wood or metal simply because it is the nearest thing available to meet the requirements. Now the customer can state the properties required and the chemist will probably get very near to meeting all of them with a "new" substance.

Use of plastics has revolutionised production methods in many instances, for the plastic material is, as the name implies, capable of being moulded.

A recent American survey showed that plastics now exceed most of the non-ferrous metals, including aluminium, in annual tonnage. In the past decade production has leaped upward to a 600 per cent overall increase, American figures show. In the United States, there are now 15 major types of plastics in production, of which seven were introduced or reached major status only since the end of World War II.

WIDELY ACCEPTED

These recent strides have been made largely because plastics are no longer regarded as substitutes, but as materials in their own right. The term "synthetics" is no longer valid.

It is more than 80 years since the first plastic was produced. It was celluloid, made from guncotton and camphor by Alexander Parkes, of Birmingham, in 1864.

Only minor improvements were made until early this century, when Dr. Leo Baekeland, a Belgian chemist working in the United States, made "bakelite" from carbolic acid and formaldehyde. These substances are both liquids, yet when they are heated together they become a solid which can be moulded before it sets. Bakelite is a "thermoset" plastic — one formed and fused by heat and pressure into a final and irreversible shape.

Another group of plastics has been developed which can be formed under heat to harden upon cooling, and then can be remelted and re-formed at will. These are known as "thermoplastics."

The thermosets are harder, more stable and more durable, and they are the plastics of heavy industrial uses. The thermoplastics fall within two main groups—the "cellulosics," based on cellulose, and the "synthetics," based entirely on chemicals.

The number of plastics with different properties is now so great that fabricators are having difficulty in keeping pace with them.

MOULDING METHODS

The sketches here show the three main forms of fabrication — injection, extrusion, and compression moulding.

Injection moulding, the leading technique in all forms of thermoplastics production, is performed by a variety of machines. The operation is shown in diagram form, with the moulding powder feeding from a hopper into a long heating chamber. The powder softens and forms into a solid but pliable substance under the heat, and in this form it is rammed out by a plunger into a mould, where it cools and sets.

Extrusion moulding is used in the fabrication of most thermoplastics. It is used in forming continuous tubing, rods, webbing, and so on, and from the extruded rods sections may be cut to produce buttons, buckles, and other similar articles. A garden hose is extruded in its finished form. The technique is broadly similar to that of the injection moulding, except that in extrusion moulding the process is continuous. Pellets of the moulding compound are fed from the hopper into a heating chamber by the pressure of an endless screw. As the material is heated it melts and it then passes out through a forming tube.

Compression moulding, used in the production of thermosets, calls for

(Continued on Page 49)

RADIO DEALERS!

EQUIPMENT MEANS RECORD NEW SALES

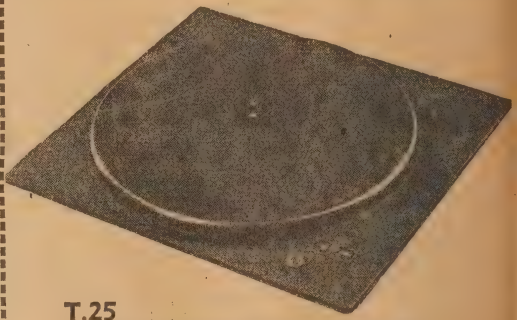
★ AVAILABLE WITH MICROGROOVE ATTACHMENT

★ **R.33 PORTABLE RECORDER AND PLAYBACK UNIT**

Two recordings and playback speeds—78 and 33 1-3 r.p.m. A single head, with excellent frequency response, performs both cutting and playback operations—plays ordinary commercial recordings, too!! R.33 cuts records of high quality up to 12" in diameter at standard or microgroove pitch. Amplifier is of original and progressive design. It has been built by engineers for engineers and men who recognise superior technical skill. The R.33 is an ideal unit for sound film applications.

★ **R.12.D RECORDER AND PLAYBACK UNIT**

This is the same unit as incorporated in the R-33 and is intended for installation and connection to your own radio or sound projector amplifier.



T.25 SUPER SILENT TURNTABLE

A professional type turntable for amateur use, available with or without pickup. The T-25 will rotate at constant speed. As a result, "wow", "flutter" and "rumble" so often found in ordinary turntables has been completely eliminated. Wide margin of reserve power and inertia of the cast turntable overcome the common tendency to slow down on the heavier passages and more violent transients. The motor, mounted on floating buffers, is synchronous and gives constant correct speed, at either 78 or 33 1-3 r.p.m.

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NEWS AND VIEWS OF THE MONTH

The "Tron Family"

WHOEVER first coined the word "electron" also gave to the English language its most overworked suffix. Since that memorable day, any electrical device put on the market has automatically qualified, it seems, to have the four magical letters t-r-o-n tacked onto its name.

Irrespective of time, race and creed, the list continues to grow and, to save you from "tronning" on someone else's corns, an American magazine has come out with an alphabetical list of the 200 words they happen to know about.

We learn, for example, that the "Acratron" is a "self-balancing" a-c potentiometer-type electron recorder. The "Charactron" is a C.R. tube displaying a series of numbers, while the "Orgatron" is an electric organ.

The Japs contribute "Detectron" for a line of radio tubes while the Swiss have their "Zyklotron," a special high frequency tube.

But the game still goes on, for the "Calutron" is "an electromagnetic type of uranium isotope mass separator"—a device which certainly sounds up to date.

The problem will become really sticky when the number of new electronic devices catches up with the possible letter combinations which can be posted ahead of the suffix At the rate things are going, that won't be long.

Plastic Embedded Circuits

WE are fairly used now to the idea of printed radio circuits, in which connections, resistors, and condensers are actually printed on the insulating material which forms the "chassis" of the equipment. This technique is now quite freely used, mainly for special devices where a high repetition rate and compact assembly is important.

A new development, not actually on the printed circuit idea, but applicable to small assemblies, is that of imbedding completely wired assembly in a solid block of insulating material.

Naturally, this material must have good insulating properties, and for this reason, polystyrene is often used.

The components included in the moulded plastic block include even the valve, as for assemblies such as this, miniature valves and subminiatures are frequently used. The latter have no socket, only wires which solder into the circuit. Whe the "bridgework" of component and connections has been put to gether, it is then embedded to forr a permanent unit, which must b discarded when faulty.

Although quite good results seer to have been achieved by norma compression or injection moulding difficulties are met with, as migh be expected, through the use of higl temperatures and pressures whicl injure components.

For this reason, special poly styrene casting resins have beer produced which are used under th polymerixation process, in whicl an initial liquid is transformed int a solid at low temperatures and pressures. The process is actually chemical one in which distinc molecules react with one anothe or form a larger molecule. Variou chemicals are used to hasten the solidification as catalysts.

One obvious applicatiion of embeding units is for the control o guided missiles, in which the assemblies are called upon to withstand very sudden and violent move-

RADIO CROSSWORD PUZZLE, No. 36

ACROSS

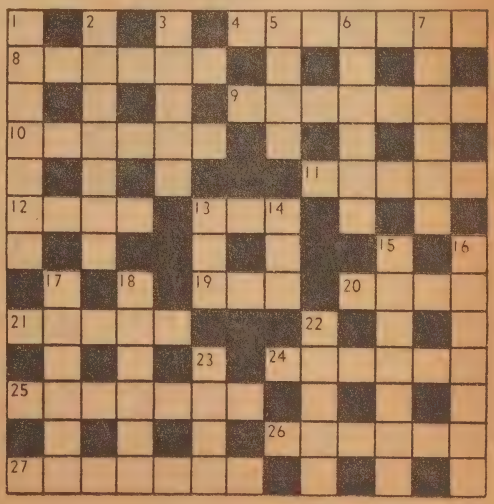
4. Dip in resonance.
8. Negative ions.
9. Valve elements.
10. Two element valves.
11. Urge forward.
12. Diaphragm attachment.
13. Unit of pressure.
19. Angle of .....
20. Screen.
21. Navigational aid.
24. Part of a circle.
25. Wave radiator.
26. Change resonant point.
27. Without magnetic property.

DOWN

1. Condensers.
2. Single wire aerials.
3. Morse recorder.
5. Balancing circuit.
6. Aerials.
7. Transmitter.
13. Transmission unit.
14. Amateur's gear.
15. Radioactive element.
16. Loudspeaker.
17. They affect hearing sense.
18. Crystal detector.
22. For measuring.
23. Against.

BELOW—LAST MONTH'S SOLUTION

B	R	A	N	L	Y		M	A	S	T	E	R		
O		S		Y		G		N		E		E		
O	P	T	I	C	A	L		T	E	S	L	A		
S		I		E		A		E		T		M		
T	A	R	G	E	T	S		N	I	E	C	E		
S						S		N		R		R		
	A	T	O	M	S		G	A	U	S	S			
C		R		O		D						M		
A	N	I	O	N		I	M	P	U	L	S	E		
R		O		I		O		L		A		G		
C	A	D	E	T		D	R	A	P	I	N	G		
E		E		O		E		T		R		E		
L	O	S	E	R	S		S	E	N	D	E	R		



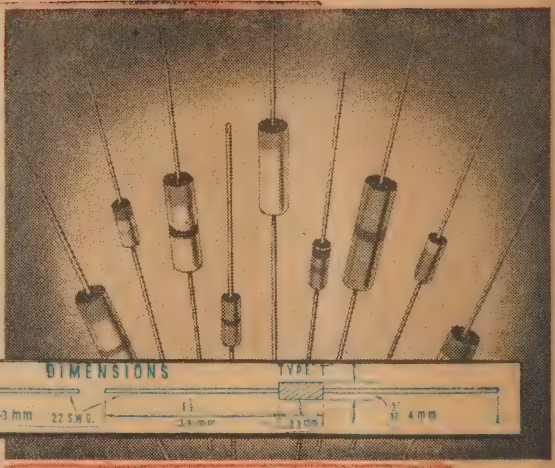
MORGANITE RESISTORS

TYPES T and R

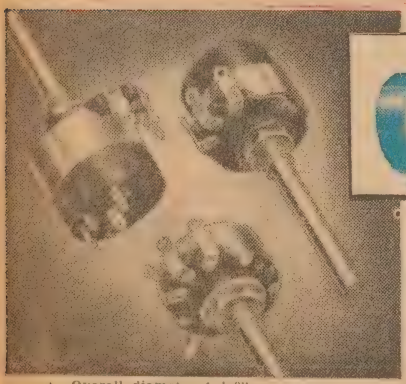
These moderately-priced BRITISH Resistors combine high performance with unusually small size. They are made accurately to their stated resistance values and are consistently stable.

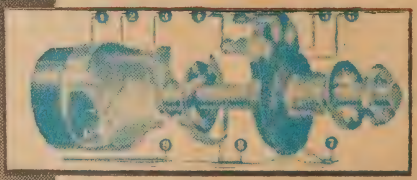
The simple construction of Morganite Resistors provides small, robust, light weight components of high power dissipation and low operating temperatures, and are colour coded to RMA Standard.

Stocked in preferred Standard values, viz., 10—12—15—18— etc., values rising in 20 per cent steps (approx.). Morganite Resistors Preferred Value Ranges are standardised in U.S.A. and U.K., and are now available in Australia.



MORGANITE MINIATURE POTENTIOMETERS





New in design . . British made . . and fully incorporates the traditional Morganite standard of quality.

Radio engineers will appreciate not only the small compact size of the Morganite Potentiometer, but the fact that it is available with a single or double pole switch of proved Morganite reliability.

SPECIFICATIONS

1. Overall diameter 1 1-8".
2. Double pole or single pole switch operated from shaft.
3. Pressure diecast rotor and shaft for accuracy and strength.
4. DOUBLE CLENCH TERMINALS eliminate noisy joints.
5. Same track design for switch and non-switch type enables interchangeability. Switch type converted to non-switch by interchanging covers.
6. The renowned MORGANITE RESISTOR TRACK LOW noise, hard wearing, wide range of standard resistance values and gradings. Rating 1 watt.
7. Standard position fixed tapping available.
8. Double prong SPRING CONTACTS, in special non-tarnishing metal for resistor sweep, maintains correct pressure for minimum noise without wear.
9. The switch withstands the most rigorous operating conditions. Rating: 2 amps, 240 volts.
10. Instrument QUALITY at LOW Prices.

THE MORGAN CRUCIBLE CO. (AUSTRALIA) PTY. LTD.

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ments. In many other cases, small units must operate under adverse humidity and temperature conditions, all of which may be greatly reduced in their effect by sealing up the unit as a whole.

★ ★ ★

Miniatures

TALKING of small assemblies, it seems pretty certain now that the valve of the future will be of the miniature type as against the larger, moulded based types we have known to date.

It is a fairly obvious development, of course, as the whole centre of radio communicatioin is now sliding down the frequency scale to such a degree that more valves are likely to be used on the high frequencies than on the broadcast band. In fact the poor old broadcast band is becoming less and less the star piece of radio, as all kinds of marvels unfold themselves in the electronic field up to thousands of megacycles in frequency.

Not all the new valves are capable of working efficiently at more than two or three hundred megacycles but there will be plenty of activity below this point which will include television stations and many growing communication links. Unless the modern valve can work well at these frequencies, it is certain to be marked down as "replacement only."

In any case, radio sets have been too bulky for years. There's no reason to make anything larger than it need be, any more than there is any reason to make things too small.

★ ★ ★

Canadian Television

IT is announced by the English Marconi company that the Canadian Broadcasting Company has ordered two outside broadcasting vehicles for its television system now in the course of construction. Marconi is already supplying the equipment for two studios in Toronto and Montreal.

Each vehicle will be a three-camera station, and be fitted with full video, audio, and radio link equipment.

The new order is worth 180,000 dollars.

Thus the complete studio and mobile side of Canadian television will be British made.

★ ★ ★

Protecting Foodstuffs

PHILIPS ELECTRICAL, of London, have devised a speedy system to examine foodstuffs for foreign bodies.

An X-ray system is devised which projects on to a fluorescent screen an image representing the largest possible area of the test piece. If any foreign body is present, the uniform image is marked by a darker area. The inspector, by means of a trigger mechanism rejects the spoiled sample.

To concrete instances typify the procedure's efficiency. Pieces of glass only .125in (.3 cm) in diameter were easily detected in bread 6in (15.2 cm) thick. Biscuits were examined at an hourly rate of 5000 packages.

Let's Buy An Argument

It may be Sydney's recent weather, it may be the effect of old age or it may be the reaction from trying to live an ordered, respected life. Whatever the reason, I find myself sour, ill-tempered and resentful. I want an argument and what better subject could a Technical (?) Editor select than things that, to me, are the product of misguided technical enthusiasm.

TAKE direct-coupling, for instance. I can't recall any other subject about which so much technical twaddle has been written. To listen to some enthusiasts, or read their literary efforts, one would think that the elimination of a poor inoffensive coupling condenser offered a cure for all the ills that ever beset an electronic amplifier.

They go off into rhapsodies about "mysterious somethings," "magical qualities" and "amazing this and thats" ad nauseum.

WHAT IS D-C?

To me, the irksome point is that so many so-called direct-coupled circuits are really not that at all.

To be sure, their promoters managed to tie a grid to a plate but they overlook the bypass condensers in the "earthy" coupling between the two cathodes. They overlook, too, the main HT bypass, forming the return path for the audio plate currents.

And if, perchance, a speaker field coil is connected to the output valve cathode—we have seen this arrangement too—there's inductive as well as capacitive reactance in the coupling system and all the elements of a delightful tuned circuit!

If this is direct coupling, then I'm a Polynesian!

I did take the matter up once with a very insistent barracker for this type of circuit. He "proved" his point to his own satisfaction - by demonstrating how superior the direct-coupled arrangement was to a quickly substituted R/C network.

There certainly was a difference but a few minutes work with valve curves showed why. With the valve and coupling network used, the voltage amplifier simply could not drive the output valve without itself overloading.

BALANCING

The demonstration, therefore, proved once and for all that direct coupling was better than badly-designed R/C coupling—a rather shattering conclusion!

Of course, I would do a gross injustice to many designers if I were to suggest that all claims could be "shot down" as easily as this one.

By resorting to push-pull, it is possible to obtain a degree of balance in the cathode and HT circuits and thereby render bypass condensers much less significant in their effect. But other difficulties remain, notably the critical operating voltages required by high Gm tubes.

With valves like the 6L6, 807, KT66 and so on, the bias is critical within a volt or so. Too little wears out the tube, too much cuts the power and lifts the distortion. Since a direct-coupled circuit amplify d-c conditions along with the signal, the valve ahead of a power tube should exhibit a rock-steady plate current—and that's a lot to ask of any tube!

NEED FOR METER

But there it is. If the initial stage doesn't happen to draw the current allowed for, it shifts the grid voltage of the output tube. Built-in compensating effects (if any) must be mighty good to keep the operating point in the centre of the curve.

As far as I can see, the only way to be sure of a direct-coupled amplifier is to run it all the time with a milliammeter in the output plate circuit. The alternative of twiddling a knob "till it sounds right" is about as rough as the proverbial cornsack.

And what is gained from all this fuss and bother? One school points to extended bass response, right down to zero cycles, if you like.

That's just the point. Most of the acoustic devices we know give up the ghost between 20 and 30 cycles, including loudspeakers, ears, drawing-rooms and grand organs.

UNWANTED BASS

The only possible use for a response below that is to amplify cabinet feedback, rumbles, and motor-boats of the electronic variety.

Our friend D. T. N. Williamson, of amplifier fame, is an eloquent witness to the truth of this statement. Having built up a really "hot" amplifier he—and we—found it almost impossible to connect the necessary preamplifiers and compensators ahead of it without running into troubles I have mentioned.

We got around it by extraordinary measures of decoupling and stabilising. Williamson, on the other hand, suggested a high-pass filter arrangement to eliminate deliberately the excellent response which the ampli-

fier exhibited between about 1 and 20 c/s.

So much for this sub-sonic "bass!"

Then there's a story about phase rotation and we'll enlarge upon this presently.

Direct coupling of the right kind will keep the phase straight between two stages at the bass end but it doesn't offset the things that happen to phase in the output transformer over the very same frequency range. Nor has it the slightest effect on phase rotation at the top end.

Our friend Williamson used it between two stages because it helped him apply nearly twice the normal amount of feedback from output to input. It was this feedback, together with the "sooper-dooper" output transformer that accounted for the special characteristics of his amplifier.

TREBLE LOSS

As for the rest, direct-coupled amplifiers suffer treble loss just as much as any other, as the result of shielding, bypass condensers and "Miller" effect.

Precisely the same limitations apply in regard to power output, harmonic and overload distortion, sensitivity and so on.

Last, but not least, the method of coupling has no effect on the impedance characteristics of the output stage. In the case of pentodes, it's as important as ever to use feedback or otherwise damp the loudspeaker, to preserve the transient response.

Need one say more?

But just before you reach for the sword, remember that I haven't said direct-coupled amplifiers should be forgotten once and for all. They are valuable in television circuits, control gear and so on but, in audio, well . . .? A rather awkward way of doing nothing in particular.

I haven't suggested, either, that your direct-coupled amplifier doesn't sound tops. Maybe it does! But for heaven's sake be realistic and admit that the performance is due to a variety of other well-arranged circumstances—not just the omission of a sixpenny component.

WILLIAMSON'S CIRCUIT

I trust you have not gained the impression that I worship at the Williamson shrine, just because his name has been mentioned and much publicity given to his circuit.

His original 807 triode amplifier (or the various versions of it) are about the best which ever got into home-builders' hands, and also the most expensive! If you overlook the difficulties of adding extra stages for gain and compensation, the end result is hard to fault. But the point is, how does the listener know it's so good?

To be quite practical, the distortion of a commercial record pickup combination can be written down at say 10 per cent. I know I haven't specified the kind of distortion or the waveform or the frequency, but the figure will do as a mental reference.

Then there's the speaker which puts all kinds of beats and peaks into the response, being aided and abetted by practical baffles, by random reflections and by standing waves in the room. Let's put all that down as another 10 per cent.

How the deuce, then, is the listener going to judge whether the amplifier introduces a mere 2 per cent or 0.2 per cent as its quota, representing the difference between a "good" and a "very good" job.

by W. N. Williams

As I've said in other places, I don't think at this stage of the game that the amplifier is nearly as critical as all that, once a certain degree of performance has been achieved. When record companies and broadcasters have pulled up their technical socks, a more rigid approach may be warranted.

In the meantime, the real problem is to clean up the devices fore and aft and make the wide-range stuff even tolerable to listen to!

Which brings me to another point. Two separate trade identities recently upbraided me no end for apparently ignoring a certain type of amplifier circuit. One, who should know better, even confessed to abandoning the Williamson circuit because this one sounded "flatter and cleaner."

What utter rot!

If there was such a difference, then I can only say that the original job must have been operating very badly for it to be apparent.

Apart from sheer pig-headedness, there is some such reason, I feel, behind most of these "one sounds better than the other" reports. Faulty components, mistakes in the wiring and oscillation effects can eternally damn the best circuit in the eyes of a home constructor. Or the preference may be based on different gain characteristics, or the ease with which it happens to attach to some other device.

And let me say this in hushed tones. Even the great can be deluded into voting for an amplifier or other gear with poor response, because of its ability to suppress the not-appreciated distortion in a programme source.

Ears are notoriously unreliable when it comes to judging sound quality. They can pick obviously restricted range or obvious distortion but, once that stage is passed, you can kid them up a hill and down dale.

PEAKS

Listen to a pickup with a 10 kc. peak for a while and you're willing to swear that a flat pickup, played immediately afterwards is lacking in highs.

Or try compensating speaker response while listening to a musical programme. After the first half hour you'll swear that black is white.

I know only one approach that really works. You set up the speaker on one side and as many instruments as you can muster on the other. Then, like the old road sign, you Stop, Look and Listen!

It becomes apparent that No. 1 pickup sounds brighter than No. 2, mainly because No. 1 has a peak up near the top end. You find out that No. 3 sounds heavy, because the input transformer is poor. You find that conventional crystal pickups are lacking in the top register, despite emphatic, but ill-informed statements to the contrary. So it goes on, ad infinitum!

I can only stand amazed at those who quite seriously suggest that

the road to good sound must not be barred by such infernal things as distortion meters, inter-modulation tests and CRO's.

Ears are like women. They react favorably or otherwise but they seldom know why!

A while ago I mentioned phase rotation and the way some folk turn handsprings at the thought of it. But have you ever stopped to think what a completely random thing phase is?

Down there, in the orchestra, there are 20, 50, 100 instruments playing away, all slightly out of tune and each string, or reed, or air column, vibrating quite independently of its neighbor. The sound waves get out into the auditorium and proceed to bounce hither and thither with gay abandon, ultimately reaching the listener's attentive ear—or the microphone.

PHASE ROTATION

Let the microphone swing slightly or the trumpeter sway forward, and you get, not only a complete rearrangement of phase, but a bit of "Doppler" effect into the bargain! This being so, I can't for the life of me see what harm a bit more phase rotation can do in the amplifier, provided that nothing else goes on at the same time.

I'm well aware that the great have been arguing this question from the days of my callow youth. But the weight opinion now seems to be that phase rotation is essentially an alternative manifestation of the same factors which ultimately limit response.

At high frequencies, for example, the presence of shunt capacitance is likely to cause phase rotation before it operates sufficiently to make a noticeable difference to the gain/frequency characteristics. Similarly, at low frequencies, coupling and bypass networks and transformers, produce their own quota of phase shift.

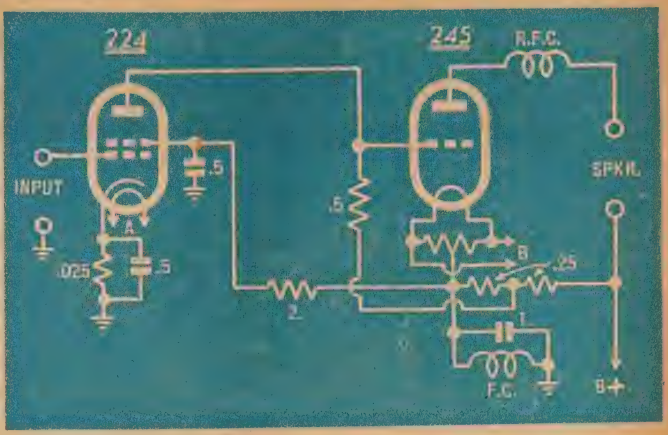
In a multi-stage amplifier, phase shift from various causes will tend to add or cancel and one can't draw much in the way of conclusion from a phase loop pattern on the CRO screen. In fact, it appears to have no practical significance, provided that frequency response conforms to the required pattern, the distortion is low and feedback paths don't become positive rather than negative at any frequency that matters—taking the last phrase in its wider sense.

COMPENSATION

There seems to be some self-contradiction here, I admit, because the best amplifier would apparently be one exhibiting the least phase shift, and Williamson's effort stands vindicated.

In the laboratory sense, that is perfectly true but just so long as it is necessary to cope with other than perfect motors, records, programmes and speakers, so long will it be desirable to impose clear limits on amplifier response. And in so doing, some phase rotation is a moral certainty.

All of which brings me to the next point. Every once in a while, I am assailed by an enthusiast who, with puritanic fervor, refuses to have anything to do with artificial doctoring of frequency response. He won't touch filters, compensators and tone controls of any kind.



A typical direct coupled circuit as referred to in this article. It was taken from one of our very early issues—hence the ancient valve types.

Some adopt the approach of a misguided purist. Others rant and rave about phase distortion. But let's have a crack first at the purist who reasons like the cotton field Negro —"If the good Lord made sound that way, then that's the way it should stay."

All of which is pure bunkum!

In an effort to get more playing time on a given disc, recording engineers deliberately taper off the bass response below a figure which may be anything from 250 to 1000 c/s, depending on who the engineer works for. In addition, he may boost the treble by a certain amount above a certain frequency, again depending on local standards.

Every pickup on the market is a compromise between conflicting design factors, and no two of them have the same frequency curve. The same applies to speakers. The purist is left in the ridiculous position of faithfully reproducing and jealously guarding a signal containing a very large amount of frequency distortion.

When the same records are played over a radio station, a suitable compensation (we hope) is applied, anyhow, to the bass register and the top, lopped off according to the ideas of the engineer and the diligence of his control operator. If it's a live programme, then the frequency law is likely to vary somewhat with the lines, the microphone, and the physical distance from the performer.

You can attribute all this to providence if you like—but not this child! If I know that frequency distortion exists, then I want to compensate for it. And if human weakness subjects my ears at times to guttural groanings or sizzling distortions, I want to be able to take some action on my own account.

RECORDING END

Phase rotation I regard as an inevitable by-product of any circuit with a changing frequency law. In other words, you can't have tone compensation, tone control and so on without phase rotation.

But just before you ban it on this account, remember that, back at the recording studio, or wherever the programme originated, the de-emphasis and pre-emphasis applied to the signal must likewise have produced phase displacement. What's more, there's a good chance that measures you apply to correct the frequency response will also tend to restore the original phase-relationships.

Once again, the purist is in the position of eliminating phase shift in his own gear, but jealously guarding the quantity inserted by those who handled the signal before him.

If you don't agree, I can only leave you to the heroic defence of something which I hope you can define. Frankly, I can't.

Just to round all this off, I must bring in our contributor to the last issue—I refer to Mr. S. V. Hosken, of stations 3LO-3AR.

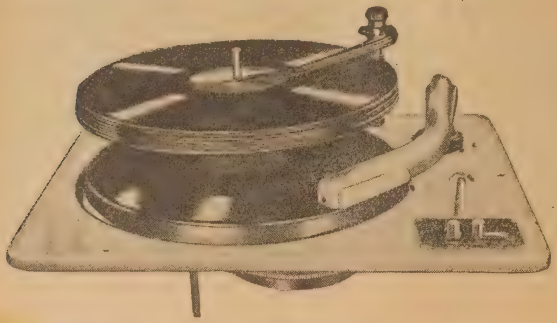
(Continued on Page 63).

RIGHT OR WRONG?

DO you think Neville is right or wrong? Apart from the fact that he has shamelessly purloined a couple of my pet ideas, I intend to be neutral and will publish the best of your replies to him if you'll write and say so—no holds barred! And if you also have a few pet ideas or "notes"—them as well. What about triodes sounding better than pentodes with feedback? That one should bring out some really good discussion. So grab your pen and paper, and let me know!

THE EDITOR.

two of the best . . .



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FROM THE SERVICEMAN WHO TELLS

AS it is, we content ourselves with occasional glances at the leaden skies and reflect that it can't go on forever. Some day the rain must cease, the mud must harden and the radio gear dry out again.

I had only just finished my last article when I came across an item in a daily paper headlining the trouble people were having with hearing aids as a result of the humid weather. Apparently the moisture is affecting the miniature microphones and earpieces with which these things are fitted and upsetting, too, the values of the tiny high-resistance components.

Whatever the ultimate details, the owners were advised to obtain a quantity of silica gel crystals, put them in a cloth bag and shut them up overnight with the hearing aid in a screw-top, airtight jar. There followed the same explanations that I gave about the color of the crystals when wet and dry.

I felt at the time, that my story might seem to be something of a "ring-in" but it obviously had a wider application than I imagined when it was written. Thus assured, I can safely go ahead with this next anecdote.

MORE HUMIDITY TROUBLE

Most of my routine voltage measurements are done on a pocket-type multimeter, which has become as much a part of me as my trousers. Whenever I want to measure volts, this handy little device always seems to be on hand.

If more accurate readings are required, I refer to an imposing instrument which I built many years ago in a moment of youthful enthusiasm. Most of its life has been spent screwed to a support near the wall and its continued accuracy has always been a point of personal satisfaction.

However, I noticed the other day that the "ohms" range was not coming to zero. Assuming that the pot. had failed, I merely made a mental note of it and turned back to the little portable fellow.

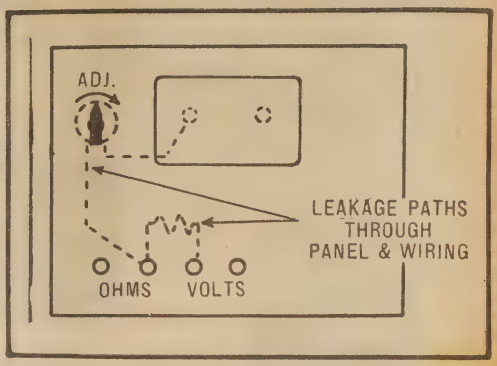

Figure 1. A startling but completely factual result of the recent high humidity. Leakage paths through the bakelite panel and the wiring shunted the voltage multipliers and ruined the accuracy of reading.

But a few hours later, the big meter gave me such a fantastic voltage reading that I knew something had really gone amiss. Just to check the point I measured the mains voltage, to receive a reading of just on 300! Whatever else the mains do at my place, they never get up that far.

It's still raining in Sydney as I write and the score in points and inches is creeping up to an all time rainfall record. I'm hearing more and more stories about the effect of moisture on radio and similar gear and it is obvious that, if local rainfall were always on this level, something would have to be done about it.

The meter was ultimately taken from its case and what a sight greeted my incredulous gaze. Every one of its pre-war cotton-covered leads was sprouting a crop of fungus, known as "lettuce" in better-informed circles. The same lush growth was apparent on every one of the paper labels.

It took me quite a while to get all the goo wiped off and the multiplier resistors were then stripped out for a check. Much to my surprise, there was only one of them off value and this happened to be the 5000-ohm resistor for the 5-volt range. All the others were right on the mark, as far as I could see.

The parts were duly wired back into the meter and the readings checked. Believe it or not, they were still hopelessly high.

I didn't discover why until after most of the wiring had been lifted free from various this and thats and careful checks made with a VT voltmeter. Believe it or not, the parallel resistance values upsetting the readings were across the bakelite panel itself. Between two pin-jacks mounted an inch apart, I could read just 7 megohms. Is that moisture or is that moisture? It took me a whole day's treatment in front of a fan and a radiator to get that panel back into shape — electrically, I mean. After that the inside of the wooden-cum-leatherette case had to be cleaned, dried and re-stained to get rid of the fungus. I wonder how many other servicemen have had similar experiences?

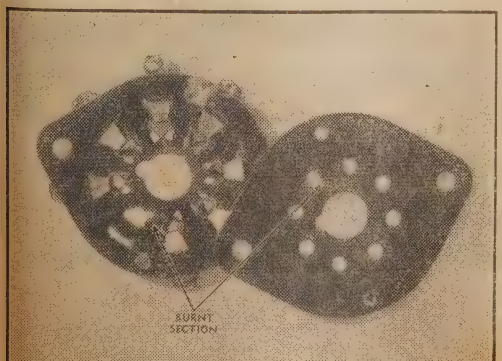

Figure 2. "Exhibit A," or the result of flux in a wafer socket combined with high voltage. Only charcoal remains between the plate and heater pin positions.

TELEVISION TROUBLES

Whatever experiences might be forthcoming, they can hardly rival those which are becoming commonplace to US servicemen handling television receivers. I can't resist the temptation to repeat a couple picked up from a current issue of the contemporary journal *Radio Electronics*.

The first case quoted involved a woman in Manhattan who complained that the television receiver was intermittent on channel 2 — whatever that means in terms of frequencies and call-signs. The serviceman, one Ed Woolman, found the set operating but the picture disappeared as he removed a large vase from the top of the cabinet.

Inspection showed that the vase had a metallic ring weight on the underside which was apparently self-resonant at the frequency of channel 2. By some process of absorption or re-radiation, it was interfering with the normal operation of the VHF-tuned circuits in the receiver.

Then there was the case of Al Friedman who was faced with a

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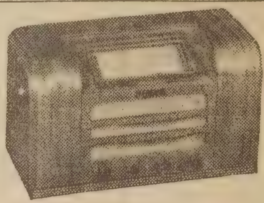

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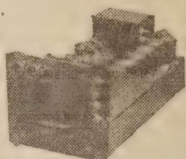

Complete with 11 valves: 2—R.F. stages, 954 acorns; mixer and oscillator, 2—955 acorns; 30 mcs. I.F. channel, 4—6AC7's detector 6H6 cathode follower 6AC7 rectifier 5V4G Coaxial switching motor, 2-volt D.C. Frequency range, 160-190 mcs.

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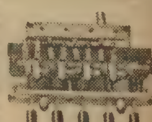

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similar case of disappearing signals, this time from channel 4. Everything about the receiver appeared to be normal and a long process of elimination finally traced the peculiarity back to some metal venetian blinds across the street.

VHF signals are notorious for their reflection and standing-wave properties and it so happened that the aerial in this case was inoperative on channel 4 unless the blinds were down.

When the occupant came home from work each day and raised the blinds, out went the signal "like a light." The phrase is strangely appropriate to television.

"GAS CURRENT"

Case number 3 was rather similar, except that the offending item was a huge gasometer in the general line of the signal from transmitter to receiver.

When the gasometer was full, there were no signals. Later, as sundry housewives baked sundry hot dinners, the gasometer level fell and in came the signals.

The television signals in some of Australia's capital cities right now would be quite safe from this type of interference!

However, I could go on like this for a long time, but it does little to communicate the finer technical points of radio servicing.

I was called out to a set the other day which "spits when I switch it on." Thinking of shorted transformers, &c., I turned my reluctant footsteps in the direction whence the call came.

Fortunately, for everyone concerned, the transformer was apparently quite intact and the spitting was traced to somewhere down under the output valve. After prizing aside a few wires and components, it became apparent that the arcing was inside the socket itself —a bakelite wafer type. There was nothing for it but to remove the faulty socket and instal a new one.

The old socket was dismantled as a matter of interest and it was immediately obvious that the trouble was essentially due to flux or "goo" which had flowed down between the wafers and provided a leakage path between the heater and the plate pin. Local heating had taken place, then a slow burning process and finally a complete breakdown. The socket, when I found it had been transformed to a lump of charcoal between the heater and the plate pins.

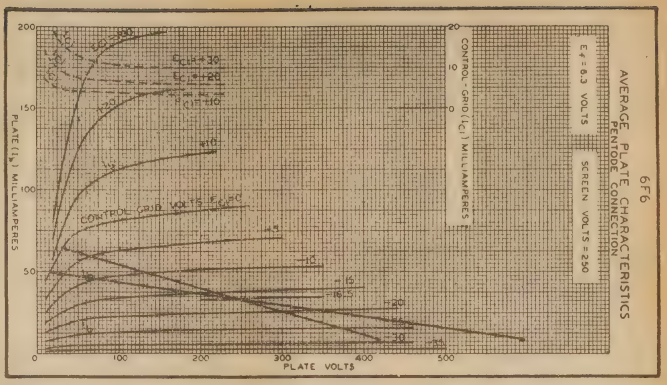

Figure 3. Curves for a 6F6 pentode. The longer loadline shows how high voltages are developed when the load resistance rises above optimum.

Such a breakdown is due to more than just the 250 odd volts normally measured on the plate. There are audio peaks superimposed on this which lift the instantaneous voltage at times to nearer 500. In fact, if no negative feedback or capacitive loading is provided, the peak voltage on sudden high frequency pulses can rise to well over double the nominal dc supply.

The same phenomenon accounts for repeated warnings against operating an amplifier without a proper load across the output circuit. In some cases enormous audio peak voltages can be developed leading to breakdown in the transformer, if not the valve or socket.

In my studious youth, the subject received a good deal of attention on the part of my instructors. How they delight to set something like this on their fiendish exam. papers:—

"Explain with the aid of similated valve curves why a pentode develops unusually high peak voltages in the plate circuit under unfavorable load conditions."

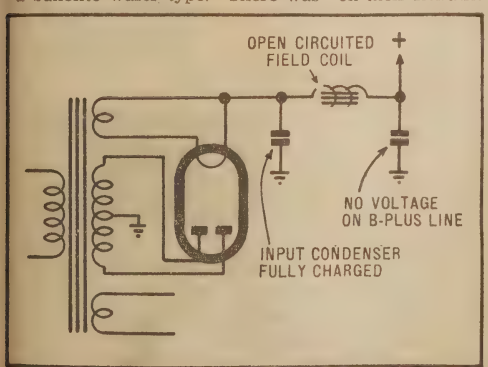

Figure 4. The case of a burned out field coil. An ohmmeter can be damaged easily when checking the circuit if the input condenser is not discharged after switching on.

In those days one had to sweat and squirm even to remember what pentode curves looked like, then struggle valiantly to recall what old "stinker" had said about it so many weeks before. The final effort was to fill a page with non-committal matter having some bearing on the subject but revealing as little as possible of one's abysmal ignorance.

Now it's simply a matter of filching a page out the R & H set of valve curves and, with superior air, saying to their draughtsman . . . "put in a line across there . . ."

However, to regain some semblance of dignity let's refer to figure 3, which is one of the said valve curves—actually for a 6F6. Two load lines have been added for purposes of illustration.

The steeper line, passing through the normal 250 volt working point is for a 7000 ohm load. For the full grid swing, between 0 and 33 volts, the plate voltage swing is between peaks of 30 and 450 ovlts.

Increasing the value of the load has the effect of making the load line less steep. For the same grid swing, the peaks of the plate swing now between about 15 and 650 volts. Without worrying about further figures and details, the effect of increased load resistance values is apparent.

RISING IMPEDANCE

The same old "stinker" I referred to earlier went on to explain that loudspeakers presented a rising impedance characteristic in the treble register so that any pentode/speaker combination is likely to develop high peak voltages at the treble end unless precautions are taken to prevent it.

The story was — and now is — complete.

Writing this, I am reminded of a scene which greeted me when I walked into the R & H lab. the other day. There was much rushing to and from, due, I gathered, to a breakdown in the mobile radio system which "the boys" maintain for the parent company. Apparently the business of producing a metropolitan daily hangs a good deal these days on radio reporting.

It turned out that a breakdown had developed across the socket of an 866 rectifier, or rather from a filament pin to the socket clamp. It looked clean enough to me and, coming close on the heels of all the stories about humidity effects, I couldn't help thinking that this was another possible case.

We servicemen and others, too, will have to learn to watch this insulation business a lot more care-

(Continued on Page 99)

Serenade your Sweetie

WITH A PORTABLE...

Spring is in the air, the holiday spirit is afoot. Make it a really happy time with a portable radio. Get the added thrill of building your own.

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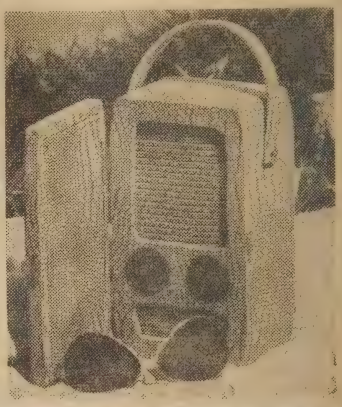
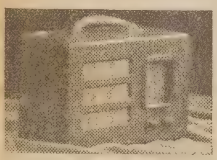
It's quite simple, provided you build to a tested and tried circuit and use only the very best components. Electronic Parts kits are compiled to specifications laid down by "Radio & Hobbies" and only the very best quality components are used. *EVERYTHING* necessary to build a first class portable is included with each kit.



CARRY SET

The smartest in small portables. This 4-valver is extremely simple to construct and is most efficient in performance. Note the smart lines of cabinet, size of which is 8¼" high x 4½" wide x 4" deep. Originally described in "R. & H", October, 1949.

Price for Kit complete with Valves, Cabinet and ALL necessary parts, £11/19/0 (Plus Postage).



SENIOR PORTABLE

Originally described in "R. & H." for December, 1948, this 5 valve B/C portable, with R.F. Stage uses either 6" or 7" speaker. A kit of parts for an A.C. power supply is also available. Cabinet size of portable 12½" x 8¼" x 6½".

SPRINGTIME PORTABLE

("R. & H." Oct., 1946). A sturdy 5 valve portable with R.F. Stage which will take any amount of hard work. Cabinet size, including hinged lid, 13" x 8 5-8" x 5½".

HANDIE-TALKIE

("R. & H." Oct., 1947, and Dec., 1947). The smallest possible 5 valve portable. Ideal for distance-getting, combined with compactness. A four valve version also available in the same cabinet. Size 7" x 4½" x 5".

MULTI-TALKIE PORTABLE

("R. & H." July, Aug., 1948). As its name implies, this is a multi unit portable. It is available as a small 4 valve B/C portable and, in addition, an A.C. power unit can be built to enable it to operate from the A.C. mains, or a vibrator unit can be built to enable it to operate from a wet battery. Size of portable cabinet 7" x 4½" x 5¼".

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KIT SET SPECIALISTS

PUTTING YOUR C.R.O. TO WORK

Once the operator understands the possibilities of the CRO all kinds of jobs can be found for it, over and above the routine testing procedures which have been described. This article discusses the behavior of output transformers and the use of the CRO for hum tests.

THE function of an output transformer is to change the load impedance to an effective value which will suit the particular output valve.

Ideally the transformer should not produce any loading effects of itself.

In practice, most inexpensive output transformers have insufficient inductance to meet this requirement so that, at low frequencies, the actual load is heavily shunted by the inductive reactance of the output transformer windings. A considerable mismatch occurs, and the ultimate result is that distortion rises and the power transferred to the load is seriously reduced.

The core, too, is commonly of limited dimensions so that any attempt to transfer large audio power causes the iron to saturate on peaks and introduces severe distortion in the output waveform. The effect is particularly noticeable at the low frequency end of the spectrum.

Distortion due to these and other closely related causes is frequently encountered during amplifier tests, either by design or accident.

OUTPUT TRANSFORMERS

To evaluate properly the limitations of an output transformer, it is essential that both the load and the CRO be connected across the secondary winding. Resistive loading allows maximum-power tests to proceed in silence but, to obtain the full story, it is often necessary to operate into speaker load and at the maximum power which the amplifier will be called to deliver in normal operation.

Naturally, too, the speaker system must be of such a size and so baffled that it can safely handle the requisite power at low frequencies.

One might begin the test with a signal at 1000 c/s, setting the controls so that the amplifier is on the verge of overload. Power output can be determined by actual voltage measurement or simply noted by observing the height of the pattern on the CRO screen with the vertical gain control in a certain position.

It is often found that somewhat higher peak power can be obtained at 2000 or 3000 c/s, due in part to a peaking in the transformer efficiency, and also to a tendency for a drooping top response to discriminate against harmonics of a high frequency fundamental.

CRITICAL REGION

Conversely, as the frequency is reduced, it is often found that the maximum undistorted power also diminishes, due to inadequate inductance, magnetic effects in the iron and poor coupling factor between the windings.

The critical region is generally below 100 cycles, where the maximum "undistorted" power output tends to fall away very rapidly. At from 50 to 30 c/s, the available power without distortion may reduce to a small fraction of that available in the middle register.

If the signal voltage is boosted in an effort to obtain high power at low frequencies, the output waveshape from a poor transformer can assume a fantastic appearance, ranging from triangular and square effects to a completely random envelope, having no relationship to the original sine wave input.

While there is some connection between maximum power figures and frequency response, the two quantities are not identical. It does not follow that a "flat" amplifier has a flat output power characteristic.

Frequency response runs are usually taken at quite low power levels in order to avoid overload effects and they do not take into consideration the maximum power limits of the output transformer in particular.

A frequency run might therefore indicate that an amplifier was substantially flat to say 30 c/s whereas, in actual fact, it may only be able to deliver one half the total peak power at 50 c/s, as compared with 1000 c/s.

The point must be considered in relation to amplifiers employing bass boost and/or negative feedback, and, especially, those in which the feedback is taken from the output transformer secondary to an earlier point in the circuit. Feedback or boosting can level a response curve, but neither can overcome the power limitations of a small output transformer.

The implications of these statements should be obvious to any enthusiast who requires plenty of power output at low frequencies.

TYPICAL CASE

As a matter of interest, oscillographs are shown which indicate the performance of an ordinary speaker transformer handling the output of two moderately-run 807 valves. The waveform at 1000 c/s is good, but, for the same output power it is hopeless at the lower frequencies.

An oscillograph is very useful on occasions for tracing and eliminating hum in amplifiers.

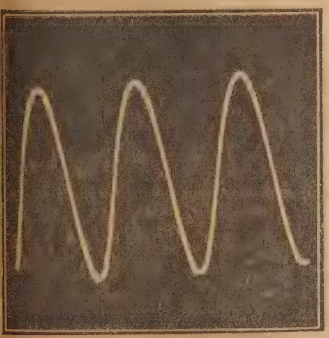


Figure 1. The output waveform from an inexpensive output transformer handling high power at 1000c/s. Input power to the primary would approximate 15 watts.

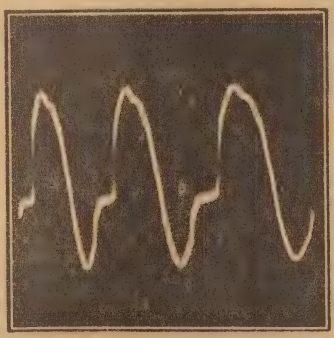


Figure 2. The same order of output from the same transformer but at 100 c/s. Note the severe distortion, due to transformer limitations.

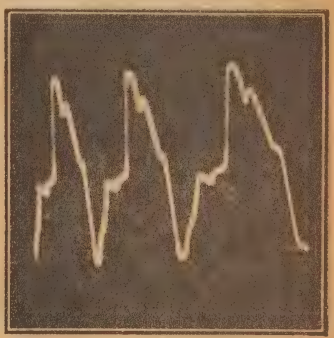


Figure 3. The output waveform at 50 c/s. Bass boost, negative feedback, &c., can level the response curve, but cannot eliminate overload distortion such as this.

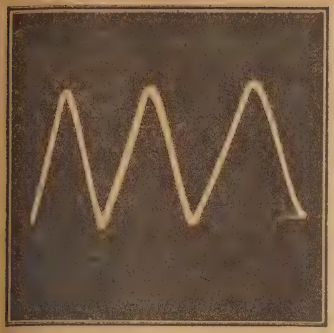


Figure 4. A hum pattern measured across the first filter condenser of a 4/5 valve superhet. The ripple is equivalent to an RMS measured voltage of approximately 10.

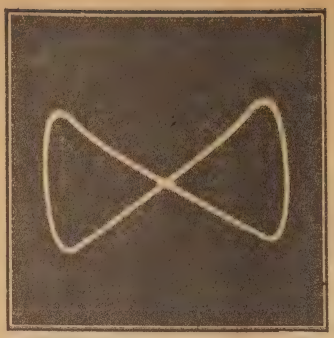


Figure 5. The same hum voltage, but using a 50-cycle horizontal a-c sweep. The figure 8 conformation indicated that the hum is predominantly 100-cycle in character.

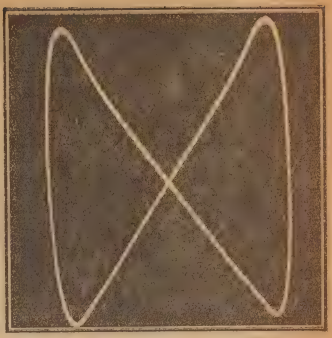


Figure 6. Showing the increased hum voltage apparent when one of the two filter condensers is removed. Such patterns show clearly the effect of extra filtering.

If one is prepared to go to a little trouble, it is possible to establish by ear what can be regarded as the maximum permissible hum level in particular types of receivers and amplifiers observing the height of the pattern on the CRO screen with the amplitude controls at certain settings.

INTERPRETATION

Some interpretation of patterns is still necessary, however, because a hum with a high-pitched component is often more objectionable than one which is more or less pure and of very low frequency. Furthermore, the efficiency of speakers and baffles at the bass end can make all the difference between a hum being objectionable or otherwise. Many old-style receivers get away with less filtering than modern sets purely because they use speakers of low acoustic efficiency.

The more usual application of a CRO in hum tests is as a purely comparative indicator. It relieves the ear from the strain of listening to a low hum and trying to evaluate the effect of various corrective measures. The effect on a CRO pattern can be observed very accurately, whereas listening tests are uncertain and often inconvenient, particularly in noisy locations.

By setting the sweep to a very low frequency, it is possible to view the hum as a wave train, but the resultant image is seldom a very pleasant one to watch for any length of time.

The alternative is to feed a 50-cycle voltage to the horizontal deflection amplifier and, for this very purpose, many instruments make a few volts available on the panel from one of the filament windings.

Since the hum is invariably related to the mains frequency, the use of a 50-cycle sweep naturally produces a steady pattern on the screen. The shape of the pattern is significant, and can give a clue as to the content and source of hum voltage.

HUM SOURCES

Hum commonly originates from heater-cathode leakage, from chassis currents or from the filter system. The first two tend to produce a predominant 50-cycle component, while the third produces a predominantly 100-cycle component, representing the output from a full-wave rectifier.

When posed against a 50-cycle sweep, a predominantly 50-cycle hum voltage will tend to produce an irregular loop or circle. Faced with such a figure, the operator can largely ignore filter problems and concentrate on sources which are likely to inject a 50-cycle component into the circuit.

WAVEFORM

Such components can be relatively pure or just the reverse, according to the method of injection. Eddy current or heater-cathode effects often produce a substantially pure 50-cycle hum but, by way of contrast, figure 9 represents a highly complex pattern. This corresponded to a high-pitch buzz produced by capacitive coupling between heater wiring and a low-level grid circuit. The pattern shows evidence of both 50 and 100-cycle components, but freely decorated with high order harmonics, representing the "buzz" component.

Figure 4 shows the hum voltage measured across the first filter condenser of an old 4/5 valve superhet —one which happened to be on the bench when the patterns were being examined. The internal sweep was set to produce three waves on the screen but the flicker was unpleasant for continuous viewing.

Figure 5 shows the same hum voltage plotted against a 50-cycle

(Continued on Page 99)

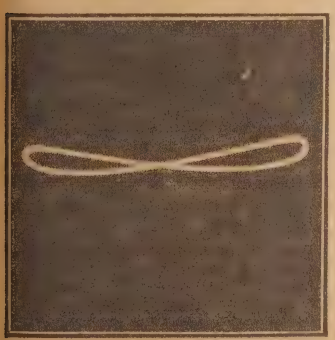


Figure 7. The ripple voltage across the second filter condenser with horizontal amplifier gain set at maximum. Comparative measurement showed it to be equivalent to .04V. RMS.

Figure 8. A pattern derived from the same point of the circuit, but with the first filter condenser disconnected. The value of the input condenser is immediately apparent.

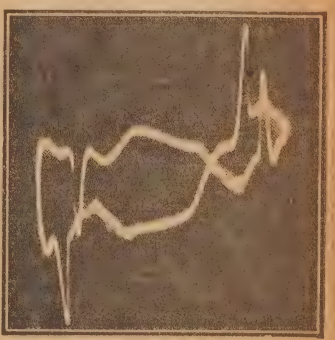
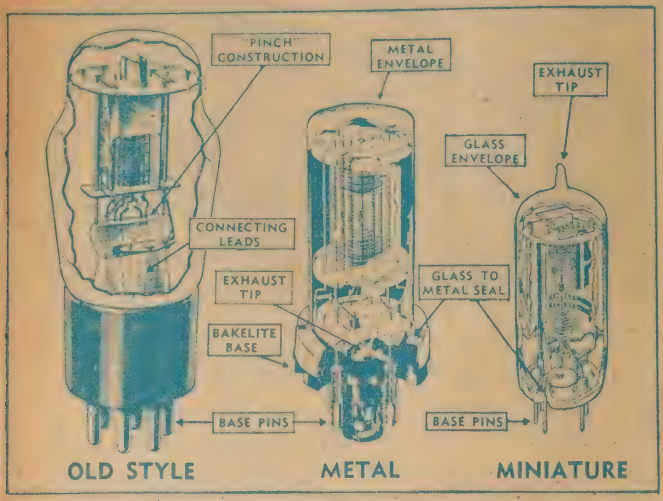


Figure 9. A highly complex pattern produced by the "buzzing" type of hum well known in high gain amplifiers. A basic 100-cycle pattern is evident in addition to the high order harmonics.



This diagram shows the mechanical evolution of the modern miniature valve.

turers managed to shorten the overall length to produce the "—GT" series and so on.

However, through all these now familiar developments, the pinch construction was retained, basically because it remained the simplest method with available techniques and machines. Unfortunately, it has a number of fundamental limitations, which can readily be appreciated.

1. Electrode structures mounted on a pinch are supported along one plane only. To prevent the structure from sagging or vibrating sideways, elaborate support micas are necessary at the top, bearing against the glass bulb. Any looseness in the electrode support or mica produces mechanical rattles and microphony.

2. Cemented bases often come unstuck from the glass and the soldered lead wires do not take properly to the plated pins.

3. The length of lead trailing down inside the valve pinch and base is excessively long, between two and three inches in many cases. Capacitance between adjacent wires is too high and there are also dielectric

NEW (RADIO) LAMPS FOR OLD

During the past few months, one new valve after another has been released on the local market. Special types are planned for local manufacture, while last month's issue carried details of a new batch of imported miniatures. Are these valves better than the older types? Are they as reliable? Can they be used in broadcast sets? Questions like these must have passed through the minds of many readers.

TO be sure, the number of valve types current in the world today is nothing short of stupendous. While local designers and enthusiasts may at times, have cursed the forces which denied them a particular valve, there is really something to be thankful for in the trade and tariff restrictions on the types with which we have to reckon.

LONG LIST

Even so, the list is sufficiently long to fill an imposing manual and it is still growing, as witnessed by the recent announcements.

Some valve groups have been introduced, in the past, on rather flimsy grounds and proper planning on a world scale could have cut the number of different types to a fraction of their present total. The new miniatures, however, are the logical outcome of special requirements and completely new manufacturing techniques.

To understand the implications of this statement, it may be wise to trace briefly the developments and the factors which have changed valves from the big 4-pin lamps of the past decade to the present highly efficient miniatures.

One can quite understand the reaction of engineers, in the early days, faced with the problem of producing the first commercial valves. Quite naturally, they turned to techniques and machines already in use for a closely related product—the familiar electric light globe. From this source they inherited what was commonly known as the "pinch" type construction.

This involves sealing a number of support wires in the flattened end of an inner glass tube—the pinch. Inside the envelope, the wires are trimmed and bent, then spot welded to the various support rods and leads from the electrode structure.

Underneath, other leads trailing from the support rods pass down into hollow pins set in a bakelite base. This base is cemented on to the glass envelope as the final step in manufacture.

MASS PRODUCTION

Mass production cleaned up some of the obvious crudities of the earliest valves. Big, unlovely glass bulbs gave place to smaller and more becoming domed bulbs. The heterogeneous collection of bases, 4-5-6-7 pin, American, Continental and so on gave place to a more universal basing system, namely the octal. Manufac-

losses in the ordinary base material.

Objections 1 and 2 can be minimised by careful production control, but 3 remains as a source of electrical loss at frequencies beyond a few megacycles.

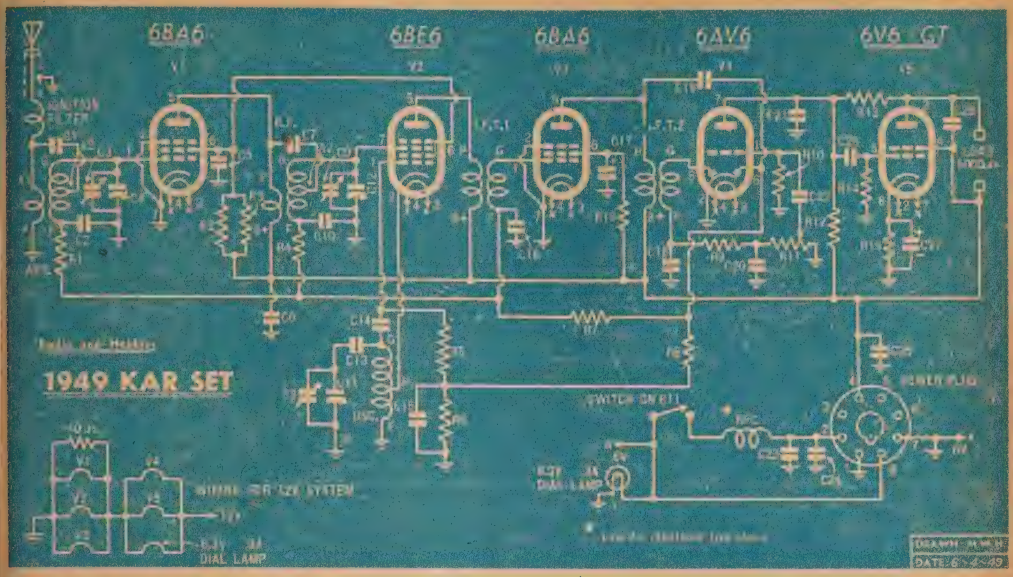
Engineers designing short-wave receivers find that too much of the L, C and R in their tuned circuits is concentrated inside the valve and socket, where it becomes a liability. Thus, ordinary types are fair enough to 15 Mc, poor to 30 Mc, and becoming progressively more hopeless after that.

METAL VALVES

Appreciation of these problems led to the development of metal valves, as a partial answer. Though many of these are designedly interchangeable with glass equivalents, they employ a new construction principle, as will be evident from the illustration.

The pinch is replaced by a ring of individual glass bead seals, each one carrying a support wire which passes straight down into the base pin. The leads are shorter and careful positioning minimises troublesome capacitance effects.

Inside the valve, the ring wires give better support to the electrode structure.



Our popular car radio is a good example of how to use new valv es. Older types could have been 6U7, 6A8, 6U7, 6B6 and 42.

A significant development from the metal valve and its base was the American 8-pin "Loktal" and the European 9-pin equivalent, as used on the well-known EF50.

In these valves the support wires themselves become the contact pins, thereby eliminating the mechanical problems and losses associated with a bakelite base. The base on the Loktal series is purely a metal shell which supports a centre locating spigot.

To produce the present miniatures, designers succeeded in accommodating an equivalent electrode structure inside a much smaller glass envelope and the whole is sufficiently light to obviate the need for any form of artificial base. The wires supporting the electrodes simply protrude straight through the bottom of the envelope and plug into the socket.

MINIATURE BASES

There are two standard miniature bases. The first a 7-pin "button" base, best known to date by its use in the miniature 1.4 volt battery valves. However, it cannot properly accommodate double triodes, converters and other complex types needing more than seven connections.

The alternative is the 9-pin "noval" base, best known in this country because of its adoption by the Philips organisation for their "Innoval" series.

Neither base is radically new, the 7-pin button type having been used for years for special VHF valves like the "900—" series. The "new" aspect is their application to mass production for valves of all kinds, whether required for VHF work or not. There are miniature rectifiers, for example, miniature voltage regulators and miniature output valves.

Several important factors have brought this about, the most important having already been mentioned—the need for better performance on high frequencies.

The new miniatures greatly reduce lead length and capacitance inside the valve, thereby allowing the provision of more efficient tuning circuits at high frequencies. Basing losses are eliminated and there is a general tendency to reduce the electrode structure itself to smaller dimensions, giving a further boost to high frequency performance.

The average a-c miniature can be used successfully to 100 Mc. odd, while specially designed types more than double this figure.

However, quite apart from electrical characteristics, small valve dimensions are important in most VHF equipment, notably pack sets, mobile radio of all kinds, radar, FM and television. In some cases, the need for portability is obvious. In others, the problem is one of packing a necessarily large number of valves and circuits into a chassis of reasonable dimensions.

All this has a very important bearing on future operations, but how does it affect the designer of an ordinary domestic receiver?

MANTEL SETS

If the set in question happens to be a mantel job, the answer is obvious. The use of smaller valves makes possible a more compact layout. Or, if smaller overall dimensions are not the object, a cleaner and less crowded layout can be effected.

For console receivers it is pretty much of a toss-up. The new miniatures provide something of a talking point in themselves but, by way of contrast, a miniaturised chassis in a large console can look very insignificant to the uninformed purchaser.

However, the desire to standardise types will probably lead to the ultimate and general use of miniatures for all sets, though many will stick to the well-known "-GT" types for the time being.

The same trend will doubtless be evident in our own circuits—a gradual change-over to the miniatures of one type or another.

This will pose some problems for the home constructor. You will have to learn to handle the new sockets, to make cleaner, smaller soldered joints, using less flux. You will have to sort out in your minds the new pin arrangements and get away from the "heater to pins 2 & 7" complex. Reliance will have to be placed in basing diagrams, for the pin connections are likely to vary quite a deal, according to the requirements of the type.

NEW CONNECTIONS

A few years ago, readers felt the same way about the then new octal base. The lugs looked smaller and dangerously close together. We had to retin the iron tip and clean up soldering methods. We dearly missed the two thick pins for the heaters.

It's just the same story over again and, after the first few experiences, home-builders will handle the new sockets and connections with the same familiarity as the old.

Another problem, of course, concerns the interchangeability of types. Can circuits using the new valves be built up around some of the older types which readers will certainly have on hand?

Years ago, when we began to pecify the 6.3 volt valves, a goodly roportion of the circuits were actu- lly built up by readers using the lder 2.5 volt types. In the same vay, there was a lag between the onventional types and the octal- ased equivalents, when these latter ecame standard.

With some limitations, the same nterchanges can be effected between he miniatures and the full-sized ypes.

One such limitation is purely nechanical, in that more chassis pace is required by the larger valves nd it will not be possible to dupli- ate compact layout arrangements. The other point is that the larger alves are virtually useless beyond bout 30 Mc. and tuning circuits or operation on these frequencies r above rely entirely on the use of uitable types.

MINIATURE GROUPING

Apart from these special features, he miniature valves can be grouped nto the same classes as the older ypes. You can take your pick of wo converter valves, the 7-pin BE6 or the 9-pin 6AN7. If a vari- able-mu R.F. pentode is required, here is the 7-pin 6BA6 or the 9-pin BD7, the latter having two diode plates incorporated for multiple- purpose operation.

For the audio end there is the 7-pin 6AV6 duo-diode triode, or the 9-pin type 6BD7. The 6AU6 is avail- able as a pentode voltage amplifier, while there are two output valves to choose from, the 7-pin 6AQ5 and the 9-pin 6M5.

To make you feel more at home, the 6AQ5 has similar characteristics to the 6V6-GT, while the 6M5 is equivalent to the EL3-NG. Similarly, the miniature 6X4 rectifier is equi- valent to the well-known 6X5-GT.

One could mention still other types which are either available immedi- ately for commercial use or ap- proaching release. Details of these types are best culled from published charts, as the need arises. After all, there are so many type numbers to be reckoned with that no one can be expected to remember them all, let alone details of socket connections and operating characteristics.

The main point, it seems, is to realise that these are just ordinary valves, more versatile perhaps, re- duced in size but along familiar lines for all that.

FIRST VARIABLE-MU

To underline the development, you may remember the first variable- mu R.F. amplifier—leastwise the first to be used in this country on a large scale. Who will forget the famous old '35?

In the process of time, the 35, with t transconductance of 1050, gave place to the sleeker 58 and a trans- conductance of 1600. Then came to 6D6, a 6.3 volt version of the same valve, followed by the 6U7-G with its octal base. About the same time, we were greeted by the metal 6K7 and its glass equivalents, all with much the same characteristics as the 6U7-G.

"R. & H." GUIDE TO POPULAR A-C VALVE EQUIVALENTS

CLASS OF VALVE	OLD STYLE 2.5V.	OLD STYLE 6.3V.	OCTAL-BASED EQUIVALENTS	METAL VALVES	"GT" & SINGLE-ENDED TYPES	MINIATURE TYPES
DIODES	——	——	——	6H6	6H6-GT	6AL5
TRIODES	27, 56	37, 76	6C5-G, 6J5-G	6C5, 6J5	6SJ7-GT (Triode Conn.)	6C4, 6R4*, 6Q4*
TWIN TRIODES	53	6A6	6N7-G, 6C8-G	6N7	6SN7-GT	6J6*, 12AT7* 12AU7, 12AX7
DIODE-TRIODES	2A6, 55	75, 85	6B6-G, 6Q7-G 6R7-G, EBC3	6Q7, 6SQ7	6SQ7-GT	6AV6, 6BD7 6N8 (Triode Conn.)
DIODE-R.F. PENTODES	2B7	6B7, 6B7S	6B8-G, 6G8-G EBF2, EBF32	6B8, 6SF7	6AR7-GT	6N8
VARIABLE-MU R.F. PENTODES	35, 58	6D6, 78 39	6K7-G, 6U7-G	6K7, 6SK7	6K7-GT, 6SK7-GT	6BA6, W77
SHARP CUT-OFF PENTODES	24, 57	6C6, 77 36, 1603	6J7-G	6J7, 6SJ7	6SJ7-GT	6AU6, 6AM6* Z77*, EF91*
POWER OUTPUT VALVES	45, 47, 59 2A3, 2A5	42, 41 6A3	6F6-G, 6L6-G, 6V6-G, KT61, EL3 EBL1, 6K6-G	6F6, 6L6, 6V6	6V6-GT	6AQ5, 6M5 6AM5
FREQUENCY CHANGERS	2A7	6A7	6A8-G, 6K8-G, 6J8-G, X61M, ECH35, EK2	6A8, 6K8 6SA7	6SA7-GT	6BE6, 6AN7
RECTIFIERS	80, 5Z3, 83V, 83		5Y3-G, 5V4-G, U52, 5U4-G, 5R4-GY	5Z4, 6X5	5Y3-GT, 6X5-GT	6X4

* For future V.H.F. applications.

Last but not least in this line came the metal 6SK7 and its glass equiva- lent 6SK7-GT, with slightly "hotted up" characteristics and a transcon- ductance of just over 2000. This is the valve designers would use who do not want to go over to the smaller valves.

But coming to the miniature series, we find the 6BA6 with a transcon- ductance of over 4000 for much the same figures of plate and screen cur- rent.

In this respect the 6BA6 reflects a general trend in the design of these miniatures, namely, higher transconductance for the same orders of plate current. This is an essen- tial feature of any valve which is to give good stage gain at high fre- quencies and this need, coupled with improved manufacturing techniques, account for the unusually high figures of transconductance.

INCREASED GAIN

It follows that this increased gain will be evident when the same valves are used for normal broadcast work. As such, it is not particularly im- portant, since it is possible to obtain plenty of gain anyway from low frequency circuits. The problem is rather to avoid trouble with in- stability due to excessive gain!

In the "Karset," there was no such trouble but the remaining com- ponents were also miniatures de- signed for the purpose. Further- more, the operating voltages were deliberately restricted in the in- terests of economy.

However, the set-builder who puts a 6BA6 in the R.F. and I.F. stages of an ordinary superhet, with high gain coils and I.F. transformers, should not be surprised if it oscil- lates from the word "go." Much will depend on the details of layout, &c., but there is a limit to which valve gain can be taken with ordin- ary components.

The same objection does not apply to converters and audio stages, of course, or at least not to the same extent.

We have not, as yet, had reason to combine the miniature high-slope types with familiar components and it is impossible to be more specific. However, when such designs do ap- pear, you may expect to see gain deliberately cut back for low fre- quency work or, alternatively, a warning that "medium gain trans- formers must be used in this cir- cuit."

Thus far, we have concentrated on types which are now readily available in this country and de- signed to meet immediate needs for mantel receivers, mobile radio-tele- phones, radar I.F. channels, and so on. These same valves will be cheap enough and plentiful enough to use also in conventional console re- ceivers, along the lines already in- dicated.

The problems of television receiver design, however, have produced a variety of other types, some of which have been imported for local use on a restricted scale. Some of these were mentioned in the last issue.

There is the 12AT7, for example, a 9-pin miniature twin-triode, which can be used at frequencies up to 300 odd Mc. It will serve as a cascade R.F. amplifier or as a mixer/ oscillator. Other twin triodes are intended for cascade or separate stage operation, allowing one tube to substitute for two. There are miniature voltage regulators, minia- ture high-performance R.F. pentodes, and so on. The enthusiast, at this stage, needs only to be aware of trends in this direction, because the day of the television receiver is still well removed from the present.

VHF VALVES

In the meantime, amateurs and their associates will welcome the opportunity to purchase VHF valves at moderate prices for use on their 144 and 288 Mc. bands.

Some may be wondering, too, about the battery valves, which were really the first miniatures to make an im- pact on the local market.

They are miniatures, in the sense

(Continued on Page 95)

STANDARD -FERGUSON- RANGE

POWER & VIBRATOR TRANSFORMERS

	A.C.	Vib.			Retail
PF 122	240	6	220	40	6.3V @ 2A	33/6
PF 125	240	6	250	60	6.3V @ 2A	43/-
PF 119	240	6	325	125	6.3V @ 4A	62/-
PF 182	240	12	200	40	12.6V CT @ 1A	33/6
PF 126	240	12	250	60	12.6V CT @ 1A	47/6
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	67/-

FILTER CHOKES

	Induct	D.C. Res.	M.A.		Retail
CF 100	50	1900	10		18/-
CF 101	30	870	25		18/-
CF 102	15	300	60		12/-
CF 103	30	420	60		26/-
CF 104	30	580	75		31/-
CF 105	15	250	80		24/-
CF 106	12	200	100		24/8
CF 107	30	360	100		34/8
CF 108	12	175	150		35/-
CF 109	20	225	150		37/8
CF 110	12	100	200		43/8
CF 111	16	165	200		45/10
CF 112	10	70	250		46/2

SPECIAL CHOKES

					Retail
CF 113	.5 / 20	70	250 / 50	Swinging choke	30/6
CF 114	1.1	23	375	Ballast choke	24/-
CF 115	.017	.6	2 amps	L.T. choke	10/-

OUTPUT TRANSFORMER TO VOICE COIL

Full Frequency Range (30-15000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	44/10
OP23	3250 SE	12.5, 8.4, 2.1	10	65/1
OP19A	5000 PP	12.5, 8.4, 2.3	15	102/10
OP31	4500 PP	15.5, 12.5, 8.6, 2.8, 2	20	36/9
OP63	10000 PP	15, 3.75	15	100/-
OP64	10000 PP	12.5, 8.125	15	100/-
OP65	10000 PP	8.4, 2.1	15	100/-

OUTPUT TRANSFORMER TO VOICE COIL

Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	130/-
OP25/16	10000 PP	16, 4	15	130/-
OP25/15	10000 PP	15, 3.75	15	130/-
OP25/12	10000 PP	12, 3	15	130/-
OP25/10	10000 PP	10, 2.5	15	130/-
OP25/8.4	10000 PP	8.4, 2.1	15	130/-
OP66	5000 PP	8.4, 3.7	15	130/-
OP67	5000 PP	15, 6.5	15	130/-

OUTPUT TRANSFORMER TO LINE—

Full Freq. Range.

OP22	3250 SE	500, 125, 8.3	10	65/1
OP19b	5000 PP	500, 250, 125	15	102/10
OP31	8000 PP	500, 250, 125	15	82/10
OP62	10000 PP	500, 125	15	100/-

OUTPUT TRANSFORMER TO LINE—

Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	130/-
OP25/250	10000 PP	250, 62.5	15	130/-

VIBRATOR TRANSFORMERS

Code No.	Prl. V.	D.C. Out.	MA	Buffer Full Sec.		Retail
VT 100	32	200	40	.005	Sync.	27/-
VT 101	6	90	15	.008	"	19/6
VT 102	6	150	25	.005	"	23/10
VT 103	6	200	50	.005	"	25/-
VT 104	6	250	60	.005	"	37/-
VT 105	12	250	60	.005	"	37/-
VT 106	6	300	75	.008	"	52/-
VT 107	6	250	60	.005	Sync. Low Rad.	30/6
VT 108	12	90	15	.008	Sync.	21/8
VT 109	24	90	15	.008	"	23/8
VT 110	12	150	25	.005	"	23/10
VT 111	24	150	25	.005	"	26/6
VT 112	12	200	50	.005	"	25/-
VT 113	24	200	50	.005	"	26/6
VT 114	12	300	75	.008	"	54/2
VT 115	24	300	75	.008	"	55/6
VT 116	24	250	60	.005	"	30/-
VT 117	12	250	60	.005	Non Sync. Low Rad.	31/-
VT 119	32	150	25	.005	Sync.	25/6
VT 121	6	180	30	.005	"	25/4
VT 122	6	400	50	.005	"	50/-
VT 123	12	320	125	.005	Sync.	63/3
VT 124	32	250	60	.005	"	30/-
VT 127	6	200	50	.005	Sync. Low Rad.	29/8
VT 128	12	250	60	.005	Sync. Low Rad.	38/-

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	50	6.3V @ 2A	24/-
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	30/-
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	30/-
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	34/-
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	34/-
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 150	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	46/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	46/-
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	56/-
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	66/-
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	60/-
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	70/-
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	110/-
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	111/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A, 5V @ 3A	144/-
PF 201	240	225	50	6.3 @ 2A	29/11

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	Retail
MT111	500	12.5, 8, 2.3	10	36/9
MT100	600	4, 3	15	36/9
MT101	500	15	15	36/9
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	66/-
MT125	600, 500	15, 12.5, 8.4, 6.5	25	66/-

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	85/-
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	111/-
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	200/-
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	276/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	39/10
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	10	45/8
OP39	5000, 2500 SE	15	10	39/10
OP33	5000, 2500 SE	5, 2.7	10	39/10
OP41	5500 SE	3.7	10	46/-
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	36/9
OP2	5000 PP	12.5, 8, 2.3	15	65/1
OP35	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP3	6600 PP	12.5, 8, 2.3	15	65/1
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP4	10000 PP	12.5, 8, 2.3	15	65/1
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	65/1
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	76/2
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	93/8
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	32	116/8

OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	39/10
OP44	5000, 2500 PP	500, 250, 125	10	47/-
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	81/4
OP6	5000 PP	500, 250, 125	15	65/1
OP7	6600 PP	500, 250, 125	15	65/1
OP50	8000 PP	600, 300, 120, 60, 30	15	126/-
OP8	10000 PP	500, 250, 125	15	65/1
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	71/3
OP9	10000, 6600, 5000 PP	500, 250, 125	15	65/1
OP10	5000 PP	500, 250, 125	25	81/10
OP11	6600 PP	500, 250, 125	25	81/10
OP38	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	140/-
OP12	10000 PP	500, 250, 125	25	81/10
OP13	10000, 6600, 5000 PP	500, 250, 125	25	81/10
OP55	10000, 6600 PP	500, 4000, 8.4, 2.2	25	120/-
OP14	5000 PP	500, 250, 125.	32	102/10
OP48	6600 PP	140, 70.	32	117/8
OP15	6600 PP	500, 250, 125	32	102/10
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	104/1
OP16	10000 PP	500, 250, 125	32	102/10
OP17	10000, 6600, 5000 PP	500, 250, 125	32	102/10
OP36	3800 PP	17.6	60	108/7
OP18	3800 PP	500, 250, 125	60	108/7
OP61	3800 PP	100, 75, 25, 10, 5, 2	60	133/8
OP37	6400 PP	500, 250, 125	80	150/8
OP49	8800, 6000 PP	500	105	210/-
OP20	11600, 8400 PP	500, 250, 125	150	276/-

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A COURSE IN TELEVISION

PAST 16—VIDEO AMPLIFIERS

Continuing the discussion of video amplifiers, the purpose of this article is to examine the factors which limit high frequency response and suggest measures by which the response can be extended. The same provisions can be applied to oscilloscopes and other test equipment where extremely wide range amplification is required.

AS we have already pointed out, the video amplifiers in a television system must be capable of providing even gain over a range of frequencies extending from a few cycles per second to several megacycles. The top limit depends initially on the standards of the system, ranging from about 2.5 Mc. for medium definition systems to about 5 Mc. for the proposed Australian system.

PICTURE TUBES

A practical limit, however, is set by the quality of the picture tube. In small, inexpensive receivers the trend is often to design both the IF and the video channel for increased stage gain and reduced bandwidth on the assumption that the resultant loss of detail will not be apparent on a small screen.

This assumption does allow certain compromises to be made on occasions but, for more ambitious receivers, the theoretical requirements must be more nearly satisfied.

The limitations on the high frequency response of a resistance-coupled amplifier are set by capacitances which are "accidental" in the sense that they never appear on the circuit diagram. However, there is nothing imaginary about their effect on results.

Figure 1a is a traditional schematic circuit in which some of these shunt capacitances are shown dotted.

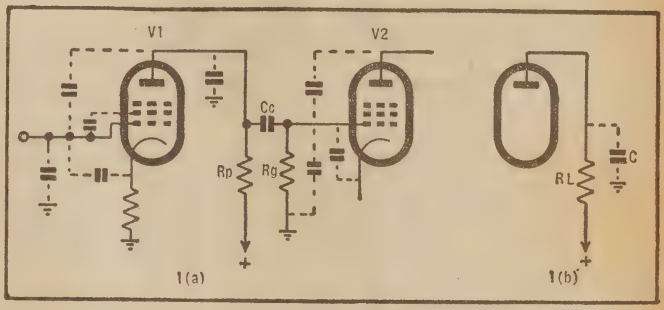
GRID-GROUND CAPACITANCE

Referring first to the grid circuit, there is inevitably some capacitance directly between grid and ground, due to the proximity of wiring and components to the chassis. Some capacitance is contributed also by the signal source, whether it be another video amplifier or the filtered output from a detector.

Of this, no more can be said, save to stress the importance of arranging the layout and circuitry to minimise length of leads and stray capacitance effects.

Additional shunt capacitance exists within the valve itself, from the control grid to the cathode on one side and to the screen on the other. It remains a constant problem for valve designers to produce valves with close electrode spacing in the interests of efficiency, while trying at the same time to reduce the extra capacitance which close spacing between electrodes tends to produce.

By way of example, the 6AC7, one of the older television pentodes, exhibits a total input capacitance of 11 pf.—this being additional to capacitive effects in the wiring and socket.



Showing effective capacities existing in a video amplifier.

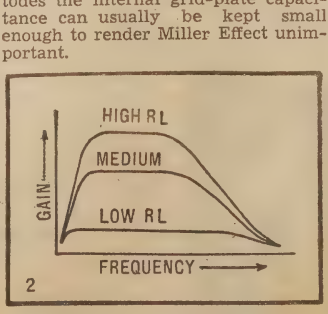
The condenser shown dotted between the grid and plate is significant as the source of the so-called "Miller Effect" in amplifier tubes.

Without elaborating on the subject at this stage, it can be shown that an amplifier with resistive plate load acquires an input capacitance which is equal to the total grid-plate capacitance multiplied by the stage gain plus one. In other words:

C in. equals C g-p (M—1), where M is the stage gain figure.

MILLER EFFECT

Miller Effect makes triode valves rather unattractive for video work, because their grid-plate capacitance figures are necessarily a great deal higher than for pentodes. With pentodes the internal grid-plate capacitance can usually be kept small enough to render Miller Effect unimportant.



Effect of load resistance on gain and frequency response.

Coming to the plate circuit, the output capacitance of the valve itself will amount to several pf., to which must be added the inevitable capacitance to ground of the wiring and components.

This is virtually in parallel with the input capacitance to the following stage, which may duplicate the characteristics of the preceding valve.

The effect of all these capacitance values on high frequency gain is related directly to the effective impedance of the circuit across which they are connected. Thus, loss of gain in a high impedance circuit is greater than in a low impedance circuit.

The impedance of the coupling circuit in Figure 1a, between V1 and V2, is largely set by the parallel resistance of Rp and Rg. In practice, it is usual to make Rp much lower in value than Rg, both to ensure a reasonable plate voltage for V1 and also to set up a favorable a-c to d-c load ratio. In most cases Rg is so much greater than Rp that its effect on the net impedance can be ignored.

SIMPLIFIED CIRCUIT

This being so, the problem of interstage video coupling can be simplified to figure 1b, in which the load RL determines the circuit impedance and C is the total shunt capacitance to ground. Coupling circuits from the detector and into the picture tube can be treated on the same basis.

For purposes of reference it is usually considered that an amplifier is flat between points which are 3db. down in relation to what can be termed the "middle frequency" response.

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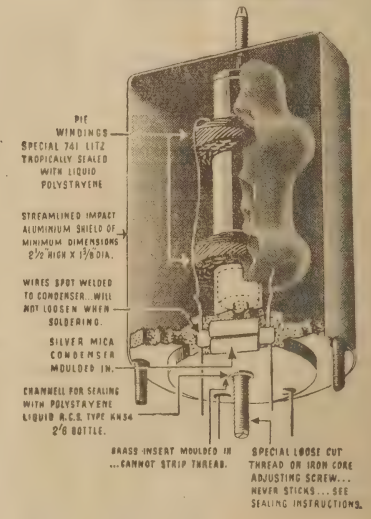
Cross section of R.C.S. intermediate transformer



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It must be remembered, however, that all such losses are accumulative and that a 3db. loss at a given frequency in each of three stages adds up to a total of 9db. Accumulative effects are particularly troublesome in the original programme and transmitting circuits, where the signal has often to pass through a variety of shapers, channels, mixers, faders and so on, before final application to the transmitter.

Referring to a single network (as figure 1b) it can be shown that the response will be down by 3db. at the frequency where the capacitive shunt reactance is equal to the load resistance.

It might be assumed that the total shunt value of "C" is about 40 pF. At 5 Mc. this represents a reactance of less than 1000 ohms, which simply means that RL must be of the same order to give a "flat" response to 5 Mc. If the accumulative effect is to be taken into consideration, the load value would have to be even less.

EFFECT OF LOAD

The effect of load resistance on gain and frequency response can be illustrated as in Figure 2.

With high values of load, as used for audio work, the frequency response is confined to a relatively narrow band, but the gain is high. A progressive reduction in the load value widens the response but reduces the gain. Unless pains are taken to choose the right class of valve and to minimise the shunt capacitive losses, the gain can deteriorate to less than unity before the desired bandwidth is achieved.

As an approximation, the gain of a pentode amplifier stage is equal to the product of transconductance and load resistance, the one being in amps per volt, the other in ohms. By way of example, the gain of the familiar 6J7-G with, say, an 800 ohm load, would be:

M = Gm. RL.
= 1.225 x 800 /1000.
= 1 (approx.).

The futility of providing amplifier stages with unity gain is obvious.

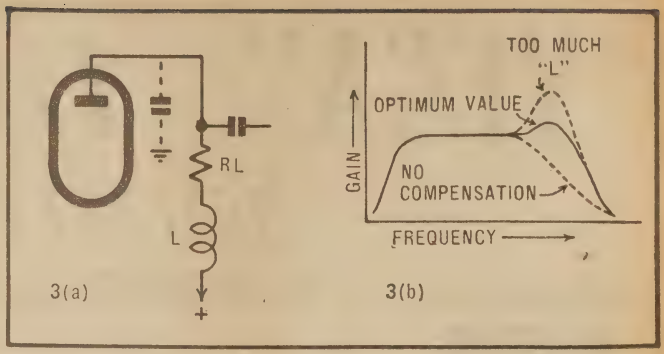
Since there is a practical limit below which "C" cannot be reduced, there is also a practical upper limit for RL. Therefore, reasonable stage gain can only be obtained by using valves with specially high figures of transconductance.

THE 6AC7

The 6AC7 mentioned earlier comes into this class with a transconductance of approximately 9 mA. /V. Assuming the same order of load, the stage gain rises to just over 7 times. Even this is low, of course, compared with the 100 to 200 times gain expected from pentode valves in audio equipment.

Referring generally to video pentodes, it is usual for types having high transconductance to show some increase in output and input capacitance. Too steep a rise in these latter values can necessitate a reduction in plate load and cancel some of the advantage gained by the high transconductance.

Thus, a rough "figure of merit" emerges for video amplifier valves based on the ratio of transconductance to inter-electrode capacitance. The relationship is not a simple one, of course, because the valve capacitance is only part of the whole. However, if two valves have the same order of transconductance, the one showing lower inter-electrode capacitances must have the advantage.



Effect of added series inductance in the plate load on frequency response.

In the face of these problems, it has become common practice to employ methods of high frequency compensation, the simplest scheme being to include a small inductance in series with the plate load, as indicated in Figure 3. The inductance tends to resonate with the total "C" in the circuit in the region where the response would otherwise fall away.

CRITICAL VALUE

The value is fairly critical and must be established for a particular set of conditions. If the inductance is too high, the resonant peak rises to a considerable amplitude, the effect being further heightened by any similar compensation in other stages.

Too little inductance gives poor compensation, the right amount just serving to square off the tapering high frequency characteristic without introducing a noticeable peak. The principle is illustrated in Figure 3.

As a guide to requirements in regard to the value of "L" a simple procedure is to plot the frequency response of an uncompensated stage and then note the frequency at which it is 3lb down. It can be assumed that the capacitance reactance is then equal to the plate load and, knowing these two values, it is possible to estimate the effective value of "C."

Another form of compensation is in the series-peaking toplift circuit, as illustrated in Figure 4. Its operation can be explained roughly as follows:

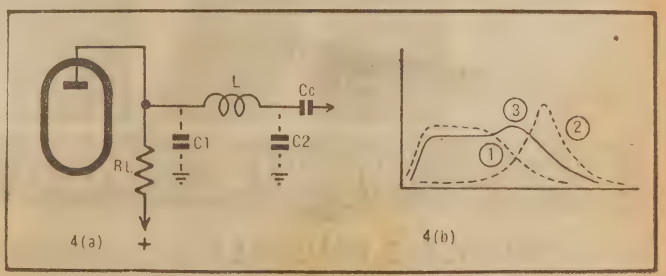
The presence of the inductance L virtually isolates the two valves and their attendant capacitances. Thus C1 in Figure 4a pertains only to the plate circuit and, for a given bandwidth, RL can be increased with a consequent increase in stage gain. The response in this section of the circuit could be illustrated by curve 1.

The output is fed to L and C2, which together should form a series circuit resonant at a point beyond the normal cut-off of RL.C1 (curve 2). The voltage across C2 is maximum at resonance so that the overall response is as illustrated by the solid curve 3.

GAIN IMPROVEMENT

In terms of gain a stage using shunt peaking may give an improvement of about 1.5 to 1 over an uncompensated stage for the same bandwidth. With series peaking the improvement in gain may approximate 2:1, while still higher ratios can be obtained with more complex methods of compensation combining shunt and series peaking.

Despite the improvement in gain offered the general tendency seems to be to avoid the more complex com-



The use of a series-speaking circuit on response.

pensating networks in favor of simple shunt or series peaking. The additional components, under mass production, can easily produce undesired resonance characteristics, while the net gain is not always as great as might be expected at first glance.

The additional compensating components and the associated wiring itself involves greater capacitive losses, tending to cancel somewhat the advantages gained.

Attacking the problem along other lines, there remains the opportunity of obtaining some compensation from the cathode circuit .

It will be remembered from previous discussion that there is considerable difficulty in effectively bypassing the cathode of a video stage to earth while preserving its response to the lowest frequency component likely to be handled. In terms of repetition rate this may be 25 or 30 c/s but, since a particular color value may be sustained for the full duration of a line, the time constant of coupling and cathode circuits must be capable of handling a signal equivalent to a few cycles per second.

In view of the obvious difficulties of arranging a cathode bypass on this basis the tendency has been to omit the bypass altogether and to put up with the resultant loss of gain due to degeneration.

SMALL VALUE

However, the cathode can be bypassed with a deliberately small value such that the degeneration is removed at frequencies where the response elsewhere, due to capacitive losses, tends to fall away. In other words, the time constant of the cathode circuit is related to that of the output circuit.

By careful choice of component values the use of cathode compensation can often allow the plate load to be increased above what would otherwise be its optimum value, so that degenerative losses on the cathode circuit are partially offset.

Allowing for the various forms of compensation, video stages are commonly found with plate load values of from 1000 to 3000 ohms, depending largely on the exact bandwidth required.

Other possible forms of compensation include "loss" networks of the type commonly employed with gramophone pickups, with values proportioned to meet requirements. However, these are not widely used in practice by reason of their inherent insertion losses.

OUTPUT STAGE

The final remarks concern the last video stage, feeding the picture tube. In a small receiver this might well be the only video stage.

To fully modulate the electron beam of a picture tube a peak-to-peak signal voltage of between 20 and 40 may be required, depending on the sensitivity of the tube.

All the requirements for video amplifiers in general apply to the final stage, so that its load also may be only a couple of thousand ohms. It follows that, to develop a voltage of, say, 30 peak-to-peak across a load of this order requires a peak current swing of 15-odd milliamps. Since the valve should not work over the non-linear portion of its characteristic, it follows that the standing plate current of the final video amplifier must be substantially higher than one-half the peak-to-peak current for full modulation. What is often required, therefore, is a tube with characteristics similar to a moderate power tube but with good high frequency performance.

HOW IT WORKS—MAKING PLASTICS

(Continued from Page 23)

the use of large fabricating machinery, as great pressures are used. The mould itself consists of two parts—one with a cavity in it representing the outside form of the article, and the other, a solid piece of steel, of which the outside represents the article's inside form. This inner part of the mould is slightly smaller than the mould of the outside, so that the space between represents the article itself. The thermoset moulding powder, mixed with some strengthening fillers, as required, is placed in the mould cavity. The press then rams the heated mould closed, fusing the powder to shape in a matter of minutes.

In practice, the moulding of plastic articles involves many delicate and intricate processes, and the apparently easy, straightforward way of making things of complicated shapes depends on very special machinery. The machines are automatic in their operation, or nearly so, and they incorporate many devices, such as an automatic measuring contrivance to dole out the amount of powder required in individual moulding processes.

In the production of some plastic articles, metal parts for a variety of purposes — such as screws and bushes—can be incorporated in the moulded articles. The metal parts to be inserted can be securely anchored in the moulding and their position accurately controlled.

HANDY DRILLING HINT

WHEN using a hand drill to bore holes in thin material such as hard metal or hard board, the sudden breaking through sometimes causes the chuck to mar the finish of the work. To prevent this, slip a rubber grommet over the bit before drilling. The grommet will provide a cushion between the bottom of the drill chuck and the surface of the material.

Naturally, this will call for a number of grommets of varying sizes suitable for the sizes of drills normally used. An alternative approach would be to cut a slit or pierce a small piece of an automobile inner tube. The one piece will then easily force on to most sizes of drill bits used in the average home workshop.

Here's your answer, Tom!

Tom is worried by a question which faced most of us when we first took up radio as a hobby. He can understand signals being conveyed along a wire but can't for the life of him see how they can be induced to travel through space. We'll do our best to explain. Whether we succeed or not is another matter.

JUST before proceeding to our role as technical father, we must hang our paternal head in shame and confess to making a most elementary "blue" in a recent article.

A correspondent takes us to task for gibing at plumbers and points out that "spirits of salts" is not sulphuric acid. Most plumbers understand fluxes, he says, and know a lot more about soldering than the average radio enthusiast.

The answer to both comments is "quite true." Maybe we were

thinking of the amateur plumbers we've seen in action in our time. And it's so long since we endured the regular "stinks" (i.e. chemistry) period in high school that a slight mental aberration is perhaps excusable.

In point of fact, "spirits of salts" is hydrochloric acid—the stuff which froths and gives off choking fumes when applied to galvanised iron.

After all that, we can proceed with the first question:

CARRIER WAVE

What really is a radio wave and what is a carrier wave? Is it a form of atmospheric conductor or something else? Also, how is it actually generated and received?

Well that's quite a question, Tom, and one that's going to require most of the page to dispose of. But let's heed the old saying . . . "Nothing attempted, nothing done" . . . or whatever it is.

We better take the question one part at a time.

First of all, what is a radio wave?

We'll start right at the beginning. You probably know that the electricity supply to your house is AC or alternating current. Leastwise that's what it is in most Australian homes.

By the term "alternating" we mean that the current flows back and forth, in this case at a rate corresponding to about 50 complete cycles each second.

If a small portion of the energy were fed to a loudspeaker instead of to the radiator, the speaker would emit a low-pitched humming sound, equivalent to a very low audible (or, "audio") note.

NEED FOR WIRES

If we could persuade the lighting authority to step up the speed of the generator and therefore to increase the frequency of the alternations, the pitch of the sound in the speaker would gradually increase to a whine. Actually, by other means, it is possible to generate alternating current of a much higher frequency—in fact, so high that it passes beyond the range of our ears at about 15,000 cycles per second.

Alternating currents with frequencies of this order can travel only in wired circuits. In other words, if you want to convey speech or music impulses directly from one place to another, you must run wires between the two places. The Postmaster-General and his cohorts are the experts in this field of operations. They provide the wires and you provide the tuppences.

Therefore, when you use the phone your voice is changed into corresponding electrical impulses having frequency components running up to a few thousand cycles. These are fed along the wires, into your girlfriends' earphone and thence into her ear. They may or may not have the desired result, according to the effectiveness of your technique!

However, as a by-product of your amorous outpourings, some odd electrical effects are going on. As the minute electrical currents flow in the wire, they create minute magnetic fields around it and the fields build up and collapse again very rapidly—in fact, at the same rate as your voice impulses.

But here's the point, the magnetic lines of force build up around the wire and collapse into it again, so that they are never apparent except in the immediate vicinity of the wire.

But, if by some cunning means, the frequency of the impulses in the wire is increased beyond the audible range and up to about 50,000 cycles per second and beyond, an entirely new set of circumstances comes about.

Just imagine an impulse travelling one way for a tiny fraction of a second. It builds up magnetic lines of force around the wire, which tend to collapse back into the wire when the impulse stops or changes its direction. But the lines don't collapse quickly enough and before the process is complete the impulse repeats its original cycle and generates new lines of force which push off the ones previously generated.

The process, in a way, is like a snake rapidly shedding its seasonal skins (if snakes actually do that). The wire continuously sheds lines of magnetic force which are pushed outward into space.

In other words, Tom, part of the energy in the wire is "radiated." By selecting the frequency of the impulses and making the wire a certain length (in other words "resonant"), it is possible to radiate quite a lot of energy into space.

Technically, the explanation may

be rather loose but you have probably caught on to the idea. Radio waves are not just conductors in space, in the sense that you apparently visualised. Rather are they electromagnetic and electrostatic fields which are radiated through space from an aerial system.

At the other end, they can be intercepted by another aerial system fed to a receiver and amplified.

The big catch, of course, is that a

radio wave as such is useless. It cannot be heard, nor does it convey any sense to the listener in its original form.

The pioneers got over this by inserting a "key" in the transmitting system which interrupted the carrier according to a certain pattern of dots and dashes. Someone at the other end, knowing the significance of the dots and dashes, could read the code and translate it into words and figures. This is a very roundabout way of mentioning what we know as morse code.

But morse is a most uninteresting thing to listen to and engineers found a way to impress speech currents on a radio wave in such a way that they varied its character, just as positively as does the morse key. The process of impressing speech (or music) impulses on a radio wave is known as "modulation."

RECEIVER FUNCTION

At the other end, it becomes the function of the radio receiver to pick up the radio wave, subtract the audible speech or music impulses and impress them on the loudspeaker or headphones.

We thus have a very happy mating of phenomena. Speech currents cannot be sent through the air, but they can be impressed on a much higher frequency "radio" wave. This latter can be made to travel through space, carrying the intelligence, and it is referred to commonly as the "carrier" wave.

Over and above that, there's a lot of extra theory. Speech and music impulses can be impressed on the carrier in various ways, giving rise to expressions like amplitude modulation, frequency modulation, pulse modulation and so on.

The radio waves can have a fairly low frequency, as for our normal broadcast stations, a much higher frequency, as for short-wave stations, or an extremely high frequency as used for F.M. stations, television, radio-telephone and so on. But, maybe you know all that.

The second part of your question reads like this:

THE RADIO WAVE

How is it (the radio wave) generated and received?

In the days when radio was very young as a science, radio waves were generated by partially mechanical means. However, the systems were very elementary and cumbersome and have been superseded by those using valves.

The basic idea is to set up a rugged tuned circuit which is resonant at the frequency on which it is desired to transmit. A large valve is coupled to this, capable of supplying pulses of energy to the tuned circuit. This valve, in turn, is driven from other smaller valves and tuned circuits, so that it supplies pulses at the appropriate instants.

The net result is that large oscillating or circulating currents are set up in the final tuned circuit—the one we mentioned in the first place, and it becomes the focal point for large radio frequency voltages and currents.

The tuned circuit is coupled, by suitable means to an aerial system, which radiates some of the energy into space as radio waves. The process of modulation is effected in the final or one of the preliminary valves, so that the "carrier" has the intelligence impressed on it.

Now comes the final part of the question. How is it received?

Imagine an aerial stuck up in the air—that should be quite easy, Tom. Along come a series of radio waves and our aerial suddenly finds itself suspended in what is a huge alternating magnetic field.

By basic electrical theory, a stationary wire in a moving magnetic field must have a voltage and current induced in it, and this voltage is communicated by the lead-in wire to the tuned circuit of a receiver in the house.

Of course, there may be dozens of signals in the air at the one time, and they go shooting down the lead-in like water down a drain. But the tuned circuit (or circuits), in the receiver is responsive only to the signal which happens to correspond to its own resonant frequency. It's up to us to tune the receiver so that the right signal is selected.

After that, the signal may be amplified and applied to a detector stage, which extracts the audio components and passes it on for more possible amplification and then application to the speaker.

MATTER OF TERMS

Well that's that. That question has the distinction of being the longest ever to be answered in these columns. Let's hope you're a little wiser after it all!

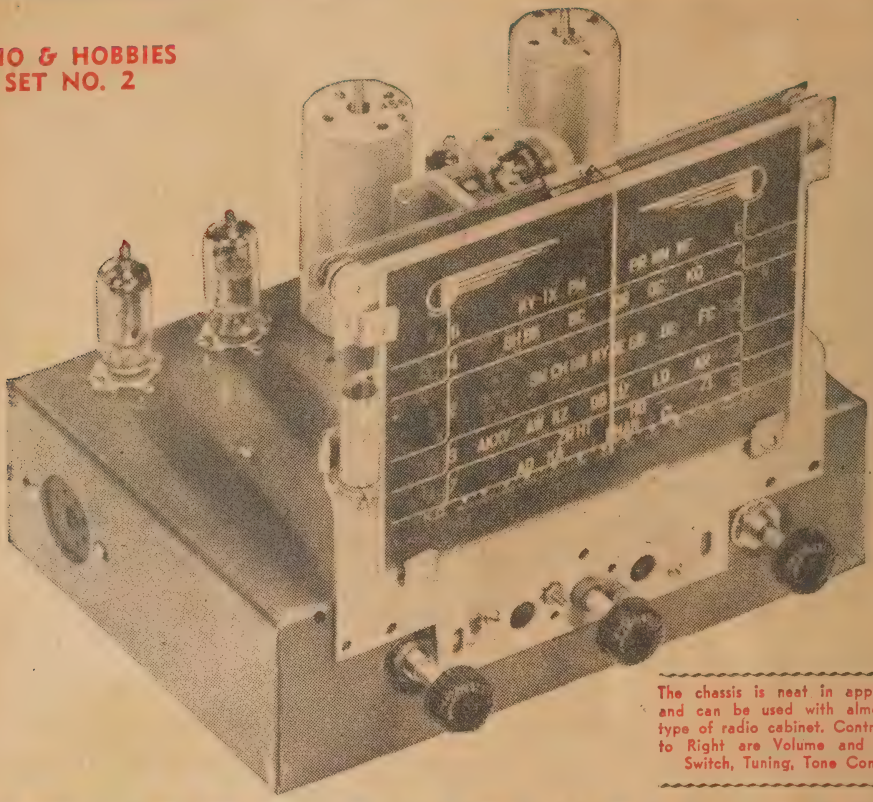
Can you please tell me what "umhos" stands for? I have often seen it in articles and valve books.

First, Tom, we must get the term right. Actually the letter "u" is only a valiant attempt on the part of typesetters to simulate the Greek letter "mu," which looks like our "u" with a tail in front. The expression can be written in full and pronounced as "micromhos." As such, it is the unit which expresses the transconductance or mutual conductance of a valve.

This property is fundamentally the ratio between a small change in milliamps of plate current for a certain valve to the grid voltage which caused the change, all other potentials remaining fixed. It is expressed in terms of milliamps per volt.

An alternative method of expression is obtained by multiplying the number of milliamps per volt by 1000, and calling the result "micromhos." Thus, a valve having a mutual conductance (or transconductance) of 3 milliamps per volt (3mA/V.) can be said to have a mutual conductance of 3000 micromhos. Conversely, a valve with a transconductance of 6000 micromhos can be said to have a transconductance of 6 mA/V.

RADIO & HOBBIES
KIT SET NO. 2



The chassis is neat in appearance and can be used with almost any type of radio cabinet. Controls Left to Right are Volume and Battery Switch, Tuning, Tone Control.

THE 1950 PENTAGRID FOUR

Carrying on the tradition of the famous "Pentagrid" series, this new set is one of the nicest little four valve jobs we have ever described. It is cheap and extremely simple to build, the current drain is light, while performence is little short of amazing for so modest a design. The compact chassis can be fitted into a console or a table cabinet, or even into a kitchen setting, if your tastes run in that direction.

by Raymond Howe

THE idea behind the introduction of the "Kit" series was covered in the article on the Kit No. 1 in the July issue. Briefly, it is to cater for those readers who want to build something larger than the simple one or two valve set, but who have lacked the confidence to tackle a larger set.

Articles on these sets do not go into a technical discourse on design. Rather, the space is devoted to a "ball-for-ball" description of what components go where, with comments on points to watch and pitfalls to avoid.

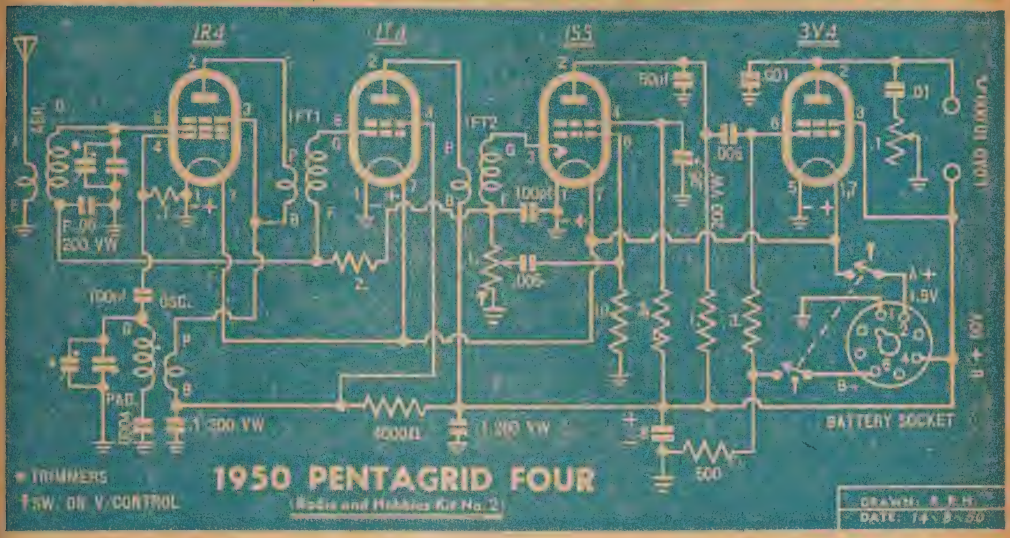
All this is supported by an under-chassis wiring diagram and photographs of the set so that nobody should have any fears of not wiring the set correctly.

So much for that. As far as this set is concerned, you need have no doubts either about its performance. Provide the set with a good outside aerial and an earth and it will do as well as, and in many cases better than, any other standard four-valve battery set. In our tests we were able to listen to quite a number of country stations in the middle of the day, even through the electrical noise prevalent in a large city.

However, to get down to the business of constructing this set, let's make the first point about tools. There are tools which are essential and others which are handy. You can settle for a medium-sized screwdriver suitable for 1-8th or, 5BA bolts, a pair of side-cutting long-nosed pliers, a sharp knife and a small soldering iron.

A conventional electric soldering iron will be out of the question in many cases unless you have on hand one which is suitable for use with a home-lighting outfit or from a car

CIRCUIT DIAGRAM OF 1950 PENTAGRID FOUR



The circuit has been carefully worked out to combine performance and simplicity.

accumulator. Mostly, it will be a case of heating the standard copper bit over a primus or suchlike. If so, use a small bit, as it does not need to hold the heat for very long in order to make one connection at a time.

Use a recognised "radio" soldering paste or flux, together with resin-cored solder. Be sparing with the flux to avoid having it run into the miniature valve sockets or under the heads of bolts holding the solder lugs.

The chassis of this set is somewhat similar to that used for the "All Battery Five" and the "Economy Five" and, in this form, should be available from the larger distributors.

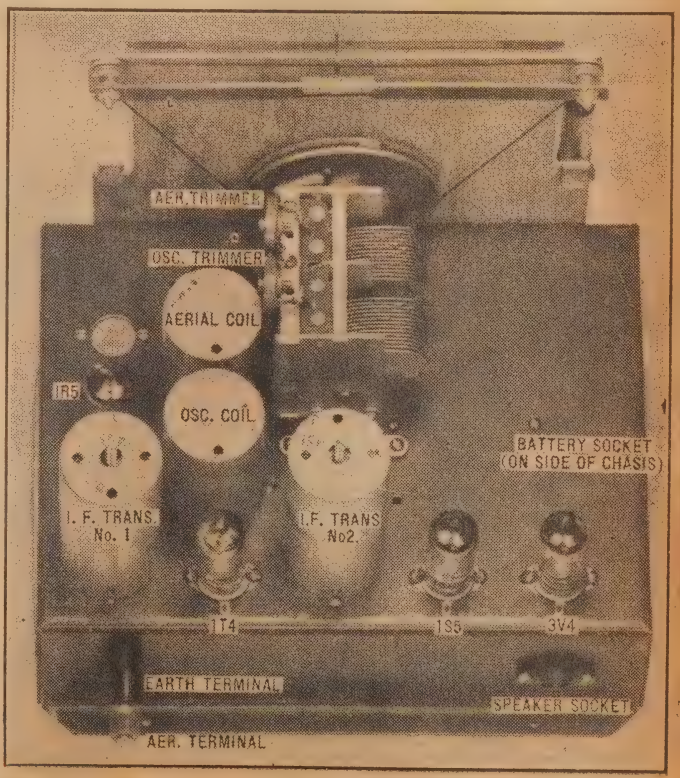
Actually, we intend to supersede the original blueprint of this chassis to take in the modifications embodying new mounting holes for the two-gang tuning condenser, a dial cut-out, speaker socket and odd minor holes.

The two holes at the right-hand front end of this chassis are unused with this set and, if desired, can be covered with a plate. There was little point in changing the design of the chassis for this set just to avoid these two blank holes. The adaptability of a chassis to a number of sets is always a good point in its favor.

NO POWER SUPPLY

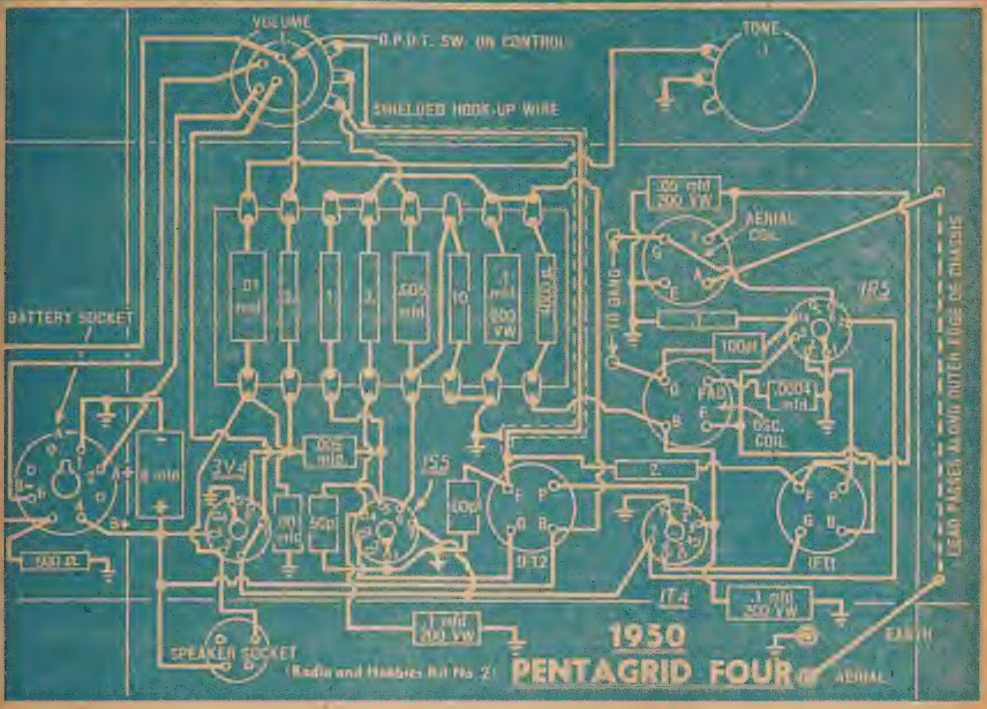
As there is no power transformer or filter choke in a battery set to worry about, we can go right ahead with the mounting of the valve sockets. Note that with these miniature valve sockets there are seven pins with a gap between pin numbers one and seven.

In the underchassis wiring diagram you will see that this gap points in a particular direction. Mount the sockets in the way indicated in this diagram as it leads to easier wiring and component layout. The octal



Here are the components above the chassis.

UNDER-CHASSIS WIRING OF 1950 PENTAGRID FOUR



This diagram has been drawn especially for the use of less experienced constructors.

battery socket has a keyway which will point toward the front of the chassis.

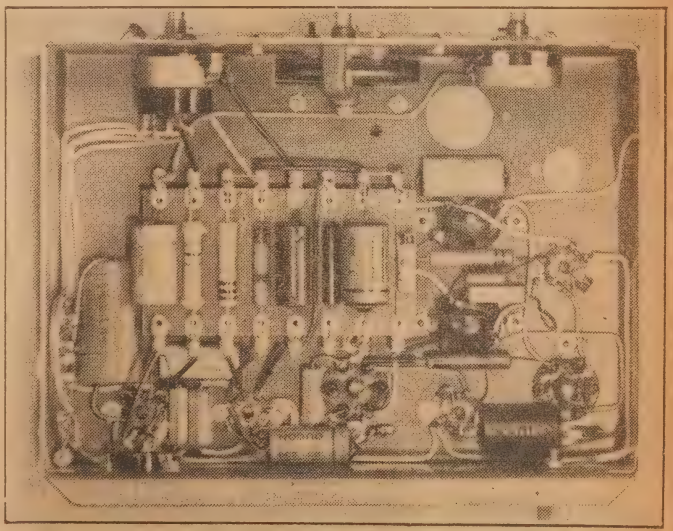
Shielding of the valves is not necessary from the electrical point of view, and we, therefore, did not use the combination miniature socket and shield. The only advantage to be gained from using these would be physical protection of the valves. As you will doubtless have your own ideas as to where the finished set is to be housed, we can leave the further choice of valve socket to you.

Mount the aerial and oscillator coils and the intermediate frequency (I.F.) transformers No. 1 and 2 in the same way as illustrated in the wiring diagram for the same reason as mentioned for the valve sockets.

To make contact with the chassis at the appropriate points use solder lugs under the following bolts. Considering the underside from the position depicted in the underchassis wiring diagram, place one under the left-side holding-bolt of the aerial coil, one on the right side of the 1R5 socket, on the left side of the 1T4 socket, under both holding-down bolts of the I.F. transformers, on the right side of the 1S5 socket, on the left side of the 3V4 socket, under each of the two bolts holding the octal socket and one under the right-hand bolt of the speaker socket.

EARTH POINTS

The "earth" signs in the wiring diagram are shown at points close to where they are actually earthed in the original set. Make sure that the bolts used for holding solder lugs make good and firm contact with the chassis, even if you have to scrape a little paint away. Be careful when tightening up the hold-



Compare this photograph with the above diagram.

ing-down bolts of the coils and I.F. transformers, as too much pressure will pull the eyelets out of the side of the aluminium can.

Speaking about the I.F. transformers, there are differences in the electrical characteristics of the one feeding the 1T4 I.F. amplifier valve and the one feeding the diode of the 1S5 second detector valve.

For means of identification, the transformers are marked "No. 1" and "No. 2" respectively. No. 1 is mounted between the 1R5 and the 1T4 and the No. 2 between the 1T4 and the 1S5. The No. 1 transformer will have a lead coming out of the top of the can. This lead is for use with valves which have the control grid connection brought out through the top of the envelope. It is not required with these miniature valves and should be clipped off close to the top of the can, leaving about 1-8th of an inch to spare to avoid shorting to the can.

Before commencing the wiring, mount the remainder of the components, such as the speaker socket, the aerial and earth terminals, the volume and tone controls, the 2-section tuning gang and the dial. In fitting the tuning gang, use an 1-8th nut as a spacing washer under each of the four mounting bolts.

Don't forget to use the insulating washer supplied with the terminals when mounting the one for the aerial. Place a solder lug between the nut and insulating washer. Naturally the earth terminal should make contact with the chassis, so use an ordinary 1-8th metal washer under the nut.

When it comes to the act of soldering, we will presume that you know the story, in that the bit should be cleaned and then well tinned. Watch the heat of the bit to avoid burning the tinning off. Apply just sufficient heat to a connection to allow the solder to run freely, particularly in the case of the terminal wires to the coils and IF transformers.

Now to the actual wiring. Commence with the earthing of the centre spigot of each valve socket to the negative filament pin of the socket, and thence to the solder lug nearest to each socket. It is a good idea, actually, to connect all earth points together with a length of busbar.

Earth pin 1 of the battery socket to the solder lug near to it, and run a wire from pin 2 of this socket to one side of one pole of the switch on the volume control. The other side of this pole of the switch connects to pins 1 and 7 of the 3V4 socket and thence in turn to pin 7 of each of the other valve sockets. The filament circuit is now complete.

You can find out which of the four lugs on the DPDT switch on the volume control are associated with the aid of a multimeter, or a battery and torch globe.

The next step is to put in all those leads which run from valve sockets to coils or I.F. transformers, from coils to the tuning gang sections, aerial terminal to aerial coil and from the speaker socket to the 3V4 socket.

"B PLUS" WIRING

This section of the wiring will include also the wiring of B-plus from the battery socket to the 3V4 socket or the speaker socket and the runs from pins 5 and 6 of the battery socket over to the switch on the volume control. Wire the 500 ohm resistor from pin 5 of the battery socket to the earthed solder lug just near it.

Now is the time for the installation of those components which are not mounted on the terminal board. Start with the 0.05 mfd. A.V.C. bypass capacitor between terminal "F" of the aerial coil and the solder lug under the left holding-down bolt. Then follow with the 0.1 megohm oscillator grid resistor from pin 4 of the 1R5 to the same solder lug. The "E" terminal of the aerial coil also is earthed at this solder lug.

Carry on around the chassis with the components as they appear in

PARTS LIST

1 Chassis 8½" x 6½" x 2½".
1 Small 2-section gang tuning capacitor (AWA).
1 Dial to suit (USL44 or similar).
1 Broadcast aerial coil, 1 broadcast oscillator coil (for 1R5 or 6J8-G).
2 Standard high-gain 455 kc I.F. transformers, No. 1 and 2.
2 Gang trimming capacitors.
4 Miniature valve sockets, 1 octal wafer socket, 1 4-pin miniature plug and socket.
1 1.5-volt dry battery and two 45-volt dry batteries (capacity to suit requirements).

VALVES

1 1R5, 1 1T4, 1 1S5, 1 3V4.

CONDENSERS

1 8 mfd. electrolytic, 2 0.1 mfd. 200VW tubular, 2 0.05 mfd. 200VW tubular, 1 0.01 mfd. tubular, 2 0.005 mfd. tubular, 1 0.001 mfd. tubular, 1 0.0004 mfd. mica (low tolerance), 2 100 pf. mica, 1 50 pf. mica.

RESISTORS

1 10 meg., 2 3 meg., 1 2 meg., 1 1 meg., 1 1 meg. potentiometer with DPDT switch, 1 0.1 meg., 1 0.1 meg., potentiometer, 1 4000 ohm, 1 500 ohm.

SUNDRIES

2 Terminals (1 red, 1 black), 3 knobs, 4in of terminal strip, approx. 7in of solder, solder lugs, nuts and bolts, 2 ⅛" bolts 1" long, etc.

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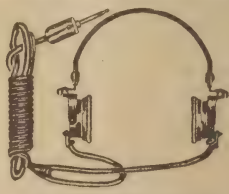

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the underchassis wiring diagram and photograph. You will note that on the tubular capacitors the outside foil is marked on the label either with the words or a black ring at one end. Where there is no label, you will find a small "blob" moulded near one end. With those capacitors shown in the circuit as connecting to "earth" or chassis, connect the end marked "outside foil" to the chassis. With the 8 mfd. electrolytic, the red end is positive.

By this time you will begin to appreciate how simple the wiring of the set really is. Nothing is crowded and it is possible to see almost every wire at a glance.

Very little else now remains to be done. It's simply a matter of installing the terminal board, mounting the eight components thereon and wiring them into circuit together with the volume and tone controls. The underchassis wiring diagram renders unnecessary any further comment in this direction.

The only wiring necessary on the top of the chassis is the mounting of the aerial and oscillator gang sections trimming capacitors. We mounted them on their side on the top of the frame of the gang with one side of each soldered to a gang section lug and the other side soldered to a solder lug held under a bolt passed through a hole in the top bar of the frame. The top plate of each trimmer should be the one which connects to the solder lug, thus earthing the adjustment screw.

Resistor Color Code

VALUE	BODY	END	DOT
10 megohm	Brown	Black	Blue
3 megohm	Orange	Black	Green
2 megohm	Red	Black	Green
1 megohm	Brown	Black	Green
0.1 megohm	Brown	Black	Yellow
4000 ohms	Orange	Black	Red
500 ohms	Green	Black	Brown

We have not shown the dial lights as being connected into circuit mainly from the point of view of keeping the A-battery drain to a minimum. You can please yourself about this point.

You are now ready for the initial trial and setting-up. However, before applying power to the set give your finished job a thorough visual inspection to ensure that there are no wiring errors and that all soldered joints meet with your approval.

Wire the batteries to the battery plug, making sure that you count the pins in the correct way, that is, when looking on to the pins. Leave the valves out of their sockets for the moment and plug the batteries in. Wire a couple of short leads to a torch globe and test each valve socket filament wiring by touching the leads between pin one and earth. If the globe glows nicely at each socket you can consider that, so far, your wiring is OK and that it is safe to plug the valve in. Torch globes are much cheaper than valves, if you see the point.

Don't be too hard on these minia-

(Continued on Page 99)

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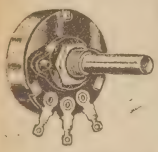

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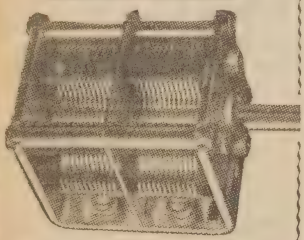

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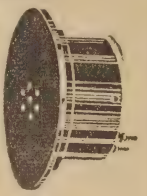

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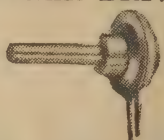
Well - known 5" speaker at less than half price, fitted with 12,000 ohm transformer which is suitable for most battery valves and 6V6 with 100V on screen. Brand new in original cartons.

19'9

Postage 1/3 extra.

VERNIER DRIVES



An English ball-driven unit with a ratio of 6-1 for ¼" spindles. Ideal for construction of small vernier dials.

To Clear at **5'-**

Postage 3d. extra.

Price's RADIO

5 & 6 Angel Place SYDNEY

FITTING AN EXTENSION SPEAKER

VERY often in a home the need arises to hear a programme at a point remote from the radio. If, for instance, the radio is installed in the living room, the pleasure of quiet background music to accompany meals in the breakfast-room is denied.

Certainly, it is possible to turn the set on full blast to do the job by brute force, but this is not likely to help the neighbors' nerves, nor is the quality of the programme heard under these conditions likely to be good.

Apart from the instance quoted, there are dozens of other situations in which the utility of the family radio can be extended by a remote speaker.

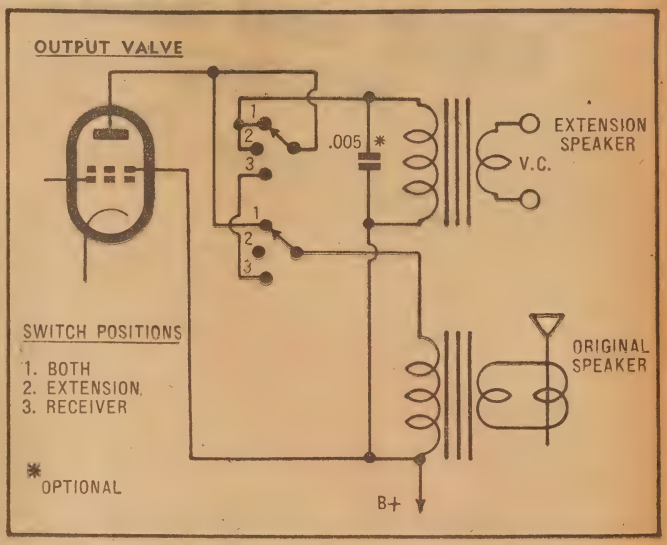
DOMESTIC SETS

This is probably a good argument in favor of a second set or a portable. However, a complete radio costs a good many pounds, as can be verified by a visit to your local radio dealer or parts supplier.

Most domestic receivers nowadays follow the same general pattern. Five valve, either dual-wave or broadcast, with a single-ended output stage. In eight cases out of ten the output valve will be a 6V6-G. Other common types are 6F6-G and EL33N. All have standard octal bases and exactly the same pin connections.

By fitting an octal socket into the top of an old octal valve base, it is possible to tap into both the plate and screen wiring of the output valve without interfering with the set's internal wiring. Simply add a switch and the primary winding of the extension speaker can be switched in or out as required.

Admittedly, the load conditions for the output valve are upset somewhat when the two speakers are operating, but listening tests show that the effect on quality is not even noticeable to the average ear. Quite an improvement on the technique of turning up the volume control!



Electrically, the circuit operates the speakers singly or in parallel.

With the aid of this little unit, you can fit an extension speaker to your radio simply and easily. Either or both speakers can be operated at the flick of a switch. No special knowledge of radio is required. It is not even necessary to take the set out of its cabinet.

The unit can be made up in any physical form which happens to be convenient. Most constructors will probably instal the switch and output transformer together on a small panel or in a case which can be mounted in a convenient position near the radio. The adaptor plug is connected to it by a length of three-core flex or twisted hook-up wire.

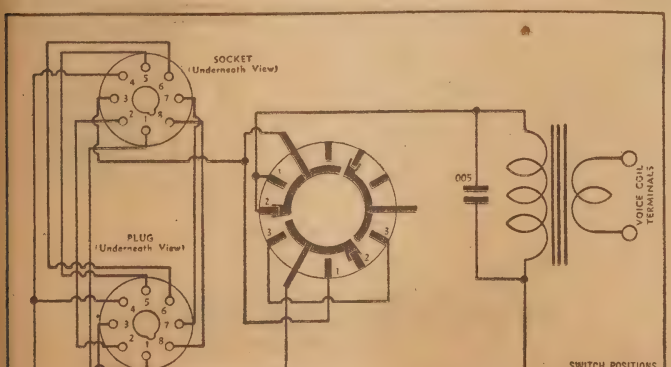
The extension speaker voice coil leads may be run with ordinary plastic power flex.

We have specified the .005 mfd. condenser across the primary of the extension speaker as an optional component. If the speaker is small and mounted on a small baffle it will probably sound a little high-pitched and the condenser helps to restore the balance.

The exact load reflected by the extension speaker transformer is not particularly critical. Anything between about 5000 and 10,000 ohms would be suitable.

Although the diagram we have drawn is for an octal-based valve, there is no reason why the idea could not be extended to any other pentode or tetrode, operating with equal plate and screen supply. With a little care, an adaptor could be made up to accommodate either the noval or button-based valves.

Almost any serviceman would be willing to oblige with an old valve from which you can obtain the base for the adaptor, and the socket can be bought as a stock line. Solder the insulated wires into the base first, allowing the interconnecting leads to extend about an inch over the top for easy soldering. After the wires have been attached to the socket, they can be pushed down into the body of the base and the two can be firmly cemented together. Drill a hole in the side of the base to take the leads to the control box before doing any soldering.

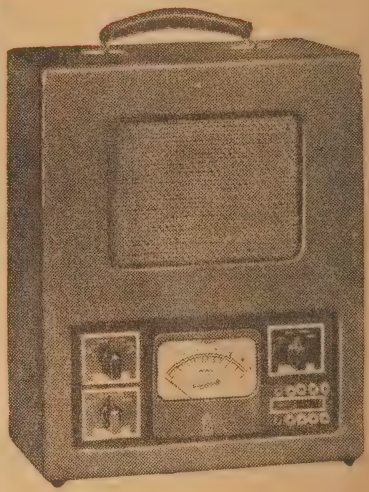


Pictorial diagram of the wiring. Components inside the dotted border normally mount in the switch box.

FAST and EASY WORK with these three.

University

Universal Speaker and Output Meter — USO.



This is a much needed and widely popular Radio Service Instrument combining the functions of an accurate calibrated output Meter with a Universal Speaker designed to suit all types of Radio Receivers and Apparatus whether A.C. or D.C. The Meter is calibrated in decimals and watts, and three ranges of 0-500 Milliwatts, 0-5 Watts and 0-50 Watts are provided. The "University" Square Rectifier type Meter is used and it comes complete with book of Instructions and all necessary Leads.

STB — SIGNAL TRACER.

Self-contained and Battery operated, the STB traces a signal **right through** the Radio Receiver from start to finish. Fault finding is quick and easy. When the probe strikes a faulty section indications are given on both Meter and Speaker. This Portable, light and sturdily constructed Instrument, is a definite necessity for fast, speedy and accurate servicing.

DCM — MULTIMETER.

This small and easily Portable Multimeter is well built and accurate. It provides the following ranges:—

D.C. Volts:—10, 50, 250 and 500.
D.C. Current:—1, 10, 50 and 250 Milliamperes.
D.C. Resistance:—0-1000 and 0-100,000 ohms.

It is entirly self-contained and comes complete with Test Leads and Instruction Card.

University

RADIO KIT SETS • RADIO & ELECTRICAL TEST EQUIPMENT

MADE BY UNIVERSITY GRAHAM INSTRUMENT CO., 5 North York Street, Sydney. Phone BU3169—2 lines.

LET'S BUY AN ARGUMENT

Continued from Page 31)

After careful analysis, he produced a special wide-band tuner terminating in a low-distortion push-pull amplifier.

This would leave me in a spot and anyone else who has discovered the usefulness of tone compensating stages in the domestic amplifier set-up. Control and pre-amplifier stages in push-pull are liable to get very messy and by the time audio is coaxed from the output stage, there would be more bits and pieces than a radar station.

I'm not trying to belittle the efforts of our worthy contributor, who has concentrated a lot of thought and ingenuity into his tuner design. It is possible that the principles can be applied to produce a more simple hi-fi circuit which will be a worthy partner for our best amplifier efforts. In the meantime, anything that's too complicated isn't good enough.

TOO COMPLICATED

That last remark goes, amongst other things, for the whole present conception of television, with or without the added headache of FM sound.

We may carry on with the present techniques for many years, but sooner or later someone will come up with a principle that will outdate our best efforts at one stroke. The whole business of 25-tube sets and 19-tube color adaptors is plainly fantastic, and more than one engineer agrees with me on this point.

With all this off my chest, I'm beginning to feel better about things. But, just as a final gesture, let me disemburden myself of two more "technicalities" which seem particularly to get under my skin.

Number one is the idea of regarding a crystal set as the ultimate reference for fidelity or clarity — the distinction between the two seems vague.

Someone builds a set, says that it goes well, gets all the stations, &c., but "it lacks the sweetness" of a crystal set. Pardon me while I tear our another handful of hair!

The whole point about a crystal set is that it offers only the bare minimum of sensitivity necessary to receive the strongest local stations. They are the only ones ever listened to and there is never any question of competing with the noise level. What's more, the earphones are normally clamped to the ears, blocking out all the distracting external sounds. With this enforced selection and concentration, is it any wonder that signals have a distinctive clarity.

But as for fidelity, have you ever examined the response curve of ordinary earphones? There's a big hump in the middle, sundry peaks on either side and beyond that—nothing!

Nor am I convinced about the fidelity of crystal detectors. Some spots on some detectors are very good but other spots are worse than any valve detector I've ever heard. To demonstrate the fact, simply feed the output into a good amplifier and listen!

Last, but not least, I have a particular aversion to the stock phrase which runs this way . . ."Theoretically such and such is the case, but in practice, it does not hold good . . ."

The phrase is plainly incongruous and self-contradictory, because theory and practice are completely complementary. One is the expression of the other. To suggest any difference between the two is tacitly to admit that our theory is incomplete (or incorrect) or that our practical observations are at fault.

EXAMPLE

Let's just take a simple example and, for the purpose of illustration, I invent a typical statement.

"Theoretically, a 6V6 should have -12.5 volts of bias but, in practice the bias can be increased to 14 or 15 volts without affecting the power output."

This statement, like so many others of its kind, appears to create a divergence between theory and practice but the fault is really in the statement itself. It is incomplete and misleading.

According to tables and graphs (which are the "theory" in this case) a 6V6 does need -12.5 volts of bias under ordinary operating conditions. Increasing the bias by the suggested amount will, in fact, decrease the power output by an amount which can be calculated theoretically and demonstrated practically with quite simple gear.

THEORY

I agree that you may not be able to notice much indifference by listening tests but this does not disprove the matter of optimum bias.

Theory also explains, if we look for it, that our ears cannot detect a change in level or power smaller than 2 or 3 decibels. Our ears are the guilty party in this instance, not the implied discrepancy between theory and practice.

And its just like that for every other case you like to think up. There never is and there never can be any discrepancy between the two. It's just that we don't know enough, or we interpret wrongly, or we fail to observe accurately the things that happen "in practice."

Thanks readers, I feel better now.

TWENTY YEARS FROM NOW

(Continued from Page 13).

to begin work and that we can expect practical results in five years.

Plentiful and cheap power is not the only benefit from atomic energy we shall be getting in 20 years. Medicine will benefit very greatly as atomic fissure makes it possible to obtain great quantities of radioactive substances for tracers and medical purposes, so that we can think of "radium treatment" in a new way. Is less than 20 years time the cost and shortage of radium which handicapped surgeons will have disappeared.

RADIOACTIVE ELEMENTS

In addition, atomic fission enables us to create radioactive elements and compounds, like "heavy water," in which the ordinary hydrogen of plain water is replaced by a special form. A whole new field opens up for chemistry.

The number of possible substances is immensely multiplied. We have not yet had time even to contemplate what some of these new "materials" may be like, or what magic we can perform with them.

These radioactive elements could, in many cases, be made before atomic fission, but only in minute quantities at immense expense. Now they are mere by-products of atomic piles and should become plentiful.

In 20 years the results of research based on these new substances should be apparent. They may be very far-reaching. Consider one piece of research alone that may be made possible with the aid of atomic-pile by-products. Scientists have never been able to unravel the process by which plants, with the aid of sunshine, turn water, carbon-dioxide, and mineral substances into living tissue.

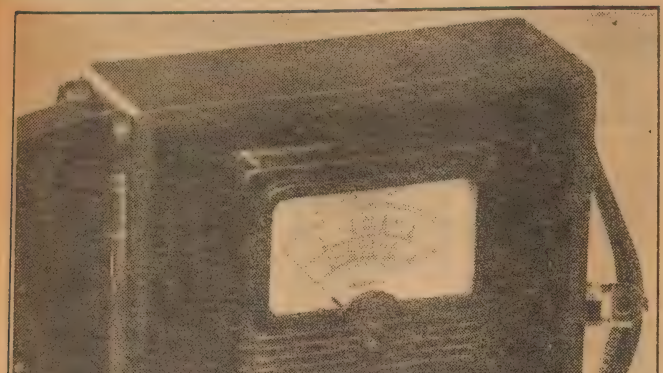
Before 20 years are passed, with "activated" materials the mystery may be solved. In 20 years we may be setting up food factories in which starches and sugars are really synthetised on the same principles as plants work. The effect would be revolutionary. It would mean the end of the danger of famine anywhere in the world.

Atomic energy will bring new responsibilities which are not limited to its use as an explosive. If we obtain energy to change climate and weather, we shall be forced to work in co-operation with other nations to avoid disaster. Warming the Polar regions, for instance, might have far-reaching effects on the weather in the rest of the world.

A HAPPIER PLACE

Many people say it would have been better if the scientist had failed in his effort to "split the atom," and that the world would have been a happier place. Myself, I like to think that this great achievement is the beginning of an adventure, perhaps the greatest adventure on which the human race has ever embarked.

Whether the adventure ends in disaster or in triumph may well be decided in the next 20 years. Disaster will come through failure to realise our responsibilities. But triumph cannot come simply by negative action. Research for the exploitation of the atoms as necessary as avoiding its use for destructive purposes.



The instrument installed in its leatherette covered case. Rubber feet are fitted and the meter can be used in either a vertical or a horizontal position.

THE STANDARD MULTIMETER

A multimeter is an indispensible item for anyone who is taking up radio as a serious hobby or for those who plan to graduate to full-time radio service work. The instrument described here is perfectly standard in design and uses parts which are readily available. Radio & Hobbies Kit No. 3.

by Maurice Findlay

BASICALLY, most multimeters for radio work are much the same nowadays. Variations are mainly in the physical shape and layout and the method of selecting ranges.

Moving coil meters have proved their accuracy and reliability for this type of work over many years. The usual sensitivity is in the vicinity of 1.0 mA, which is a good compromise. Meters of higher sensitivity are in existance but the benefits of the lighter circuit loading are offset by the greater cost and the likelihood of accidental damage to the delicate movement.

Apart from this, meters of higher sensitivity give readings which differ from the standard 0-1 mA meter in certain cases, due to the altered loading, and since readings quoted on some commercial circuit diagrams are for the standard meter, the position becomes confused with a non-standard type.

In designing a multimeter it is necessary to consider carefully what ranges will be required. Without going into this aspect of the subject too deeply, we have found by experience that it is desirable to measure direct current within a range of from about .1 mA to 250 mA, d-c voltages from about 1.5 to 1000, while a selection of ohms ranges is also desirable.

A.C. SCALES

Even country experimenters will find the a-c voltage ranges very desirable. Vibrator power supplies and rotary converters are coming into more general use and an instrument which lacks this facility is always at a disadvantage. There i no need to elaborate on the valu of a-c scales for checking powe transformer voltages, making powe output measurements, &c.

If a built-in blocking condense is included to facilitate makin relative output measurements fo receiver alignment, so much th better.

COMPONENTS AVAILABLE

Having established the genera trend of our proposed multimeter we made a systematic check wit the principal meter manufacturer in order to determine the type o meter that you are most likely t be able to buy over the counte from your usual radio supply house

The differences between the usua run of test meters are connecte with the a-c and the ohms scales.

Meter rectifiers tend to read th average value of a sinusoidal alter nating voltage. The average value i approximately .9 of the R.M.S. value which is the quantity usuall quoted. For this reason, manufac turers make some meters with

sitivity of .9 mA. The full sensitivity of the meter is used on the a-c ranges and a shunt is connected in parallel with the movement so that the same set of scales can be used for the d-c ranges.

The ohms scale on some meters is designed for use with a 1.5 volt battery while others are calibrated for a 4.5 volt battery.

Our investigation showed that 0-1 mA. meters with separate a-c scales and an ohms scale designed for 1.5 volt battery are the easiest to obtain and, accordingly, our instrument was designed to use this type.

If you have a 0-.9 mA meter on hand, it should be possible to contact the manufacturer and obtain from him a shunt to reduce the sensitivity to the required amount. It will also be necessary to obtain a replacement scale with provision for the shorter a-c ranges. A replacement scale will also be necessary if the ohms scales is calibrated for a 4.5 volt battery.

An ohms scale calibrated for a 1.5 volt battery and series adjustment is easily recognised, since the centre scale calibration will be 1.5, 15 or 150.

Of course, if you have a fair understanding of the principles involved, it would be possible to modify the circuit constants to suit out, if you are in doubt, you would be well advised to follow the course we have outlined.

As this article is intended to be largely of a practical nature, we will not attempt to discuss the theory of operation of the instrument at length but a few remarks on the general principles involved will be appreciated by the uninitiated.

READING CURRENT

The meter movement itself is a current operated device. If, for example, we wished to construct an instrument to read 2 mA full scale deflection with our 1 mA meter, it would be necessary to connect a resistor in shunt (or parallel) with the coil. This resistor must have exactly the same resistance as the coil, in which case half the current will flow through the coil and half through the resistor. You can easily see that, although the meter has only 1 mA actually flowing through it, the scale can be calibrated for 2 mA.

We quoted the above simply because it is an easy example but useful current ranges on a multimeter for radio work are 1 mA, 10 mA, 50 mA and 250 mA. In the latter case, when the instrument is reading 250 mA there is still only 1 mA passing through the meter, but 249 mA is passing through the shunt resistance.

You will have gathered from this that the value of the shunt resistance is related to the meter resistance. For this reason it is always desirable to obtain correctly-matched shunts from the meter manufacturer or, at least, shunts which are designed to work with a meter of the same resistance as the meter you have on hand.

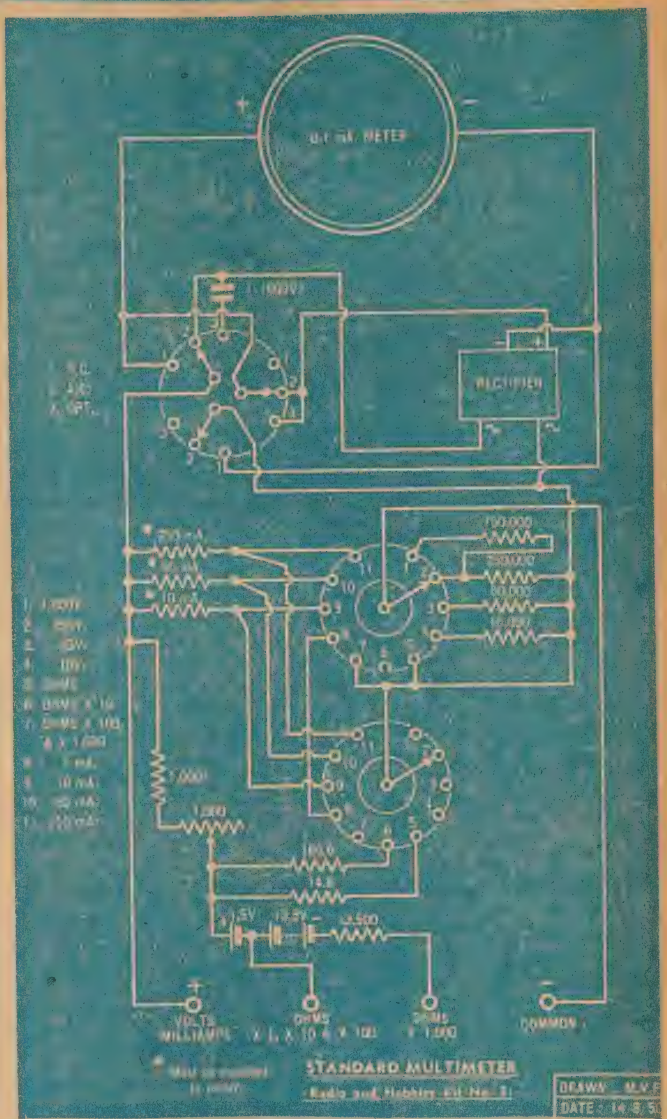
VOLTAGE RANGES

The voltage ranges are obtained by placing a resistance in series with the meter movement. The value of the resistor is such that it will allow 1 mA to pass through the meter coil when the instrument is connected across the full-scale deflection (FSD) voltage required. (The value of the resistor is calculated from Ohms law.)

For instance, if FSD is required with 1 volt applied, it can be calculated that the series resistance required is 1000 ohms. Similarly, for a FSD of 1000 volts with a 1 mA meter, the series resistance is 1 megohm.

You will probably be about to point out that we have neglected to allow for the resistance of the meter, which is usually in the vicinity of 100 ohms. However, even on the 10-volt scale this works out at only 1 per cent of FSD, with correspond-

STANDARD MULTIMETER CIRCUIT



The circuit. Note that the 1000 volt multiplier is actually 4 .25 meg. resistors in series. Higher value resistors tend to be unstable.

PARTS LIST

1 Case (see text).
1 Panel 8" x 7½" x ⅛".
1 1 mA. Meter (100 ohms).
1 5 mA. Rectifier.
1 2 Bank, 11 position Switch.
1 3 Pole, 3 Position Switch.
1 1000 ohm Potentiometer.
4 Tip-Jacks.
3 Pointer Knobs.

1% RESISTORS

4 .25 meg.
1 .05 meg.
1 .01 meg.
1 166.6 ohm.
1 14.8 ohm.

10% RESISTORS

1 1000 ohm 1 13,500 ohm.

SHUNTS (from meter manufacturer)

1 10 mA. 1 50 mA. 1 250 mA.

SUNDRIES

1 .1 mfd. 600 volt condenser. 6" length of resistor panel, 3 4.5 volt cells, 1 1.5 volt cell, hook-up wire, spaghetti etc.

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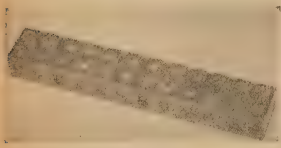
their appointment as distributors of—

BELLING-LEE components

Belling-Lee products are designed and manufactured in accordance with the standards issued by the British Standards Institution *and the Radio Component Manufacturers' Federation* and, where applicable, to the specifications of the Inter Services Radio Component Standardisation Committee. This means that Belling-Lee components are built to the *highest possible current standards.* Amateurs are invited to write to us for full data on all Belling-Lee electronic components and accessories that are now available through John Martin Pty. Ltd.

L.623/S Flex Socket Peak working voltage 7000.
L.623/P Panel Plug.

"L" TYPE.
L.1004/11.
12 Standard.
14 Head only.
L.1004/21.
22 High Voltage.



MOTOR BLOCKS
No. 561. 12-way. 15-amp.

Right-angle Plug, Single Entry. L.614.

MULTI-CONNECTORS
L.530 7-pin Flex Plug without cord grip.
L.531 7-way Chassis Socket, single panel.

L.610 4-way non-reversible.
L.611 8-way non-reversible.
L.612 12-way non-reversible.
L.613 18-way non-reversible.

Multi-Connectors

2 & 3-way Clock Connector.
L.1091/S Flex Socket.
L.1091/P Panel Plug.

Loud Speaker Plug with Extension Switch.
L.1286A Plug.
L.348 Switch Socket.

Mains Input Connector
L.1116/P 2-Pin 5 amp. Chassis Plug.
L.1116/S 2-way 5 amp Flex Socket.

Three-Pin Plug and Socket
L.1107 Plug only.
L.1113 Socket Panel.

Three-Pin Plug (Heavy Duty)
L.525 Plug.
L.1113 Socket Panel.

Multi-Connectors

Sealed Unscreened Plugs and Sockets.
L.563/EP End entry flex plug.
L.563/ES End entry flex socket.
L563/R Right-angle entry flex socket.
L.563/P 3-way Panel Plug.

Fuseholders

Single Safety Fuseholder.
L.1045/C3 with lid retaining clip.
L.1045/CS, as above, with back connection and bushes.

Twin Safety Fuseholder.
L.1033/C4 with lid retaining clip.
L.1033/C3, as above, with back connection and brushes.

Terminals ("B" TYPE)

L.1001/1W, L.1001/2W. Standard.
L.1001/21W, L.1001/22W High voltage.

"B" TYPE.
L.1001/1SW.
2SW.
L.1001/21SW.
22SW, High voltage.

"H" TYPE.
L.1005.

"F" TYPE.
L.309.

"R" TYPE.
L.1003.
L.1003/4 Head only.
P.P. 264 Insulation bush.
P.P. 366 Insulation washer.

"W" TYPE.
L.505/10 Fixed head.

"Q" TYPE.
L.1006.
L.1006/H 4 B.A. (Head only).
L.1006/H 6 B.A. (in black or red).

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Stand-off Low Loss.
L.1292, 10,000V. Peak Working.
L.1277, 5000V. Peak working.

High Voltage Bushing for Chassis or Screens.
L.1296. 5000V.

Sealed Terminals

Sealed Insulated.
L.583.

Glass Seal.
L.576, 750V., DC. Working at 40,000 feet.
1500V., DC. Working at sea level.

Glass Seal.
L.577, 1500V., DC. Working at 40,000 feet.
3000V., DC. Working at sea level.

War Office (No. 4, insulated slotted 4 B.A.)
L.541 (small).
L.542 (large).

Turret Lug

L.592. L.666.

Coaxial Plugs and Sockets

L.1249 Screened Flex Plug.
L.1250 Screened Flex Socket.
L.1266 Screened Chassis Plug.
L.1267 Screened Chassis Socket.

Line Coupling
L.616.

Through Chassis Connector
L.617.

Right-angle Plug Double Entry.
L.615.

"O:Z" Plug Pins.
L.513 3mm, 10 amps.
L.514 4mm, 15 amps.
L.515 5mm, 15 amps.
L.517 7mm, 40 amps.

Plugs

Midget Wander-plug.
L.1019.

"Bowspring" Wander-plug
L.341

Banana Type
L.378/3 3mm Plug.
L.315 0.125in. Socket.
L.378/4 4mm Plug.
L.316 0156in Socket.

JOHN MARTIN PTY. LTD.

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ingly lower values on the higher ranges.

Since the multiplier resistors have a certain tolerance and, in any case, it is not possible to read the scale to better than a certain accuracy, there is usually no point in considering the internal resistance of the meter on the voltage scales.

The resistance ranges are obtained by a simple series or combination of series and parallel circuits involving one or more fixed resistors, a battery and a variable resistor to compensate for variations in the condition of the battery and/or inaccuracies in the series resistors.

The circuit is arranged so that when the test prods are shorted together the meter reads full scale. If a resistor is placed between the prods a lesser amount of current will flow, depending on the value of the resistor. To avoid having to make a calculation each time it is desired to check an unknown resistance, the scale is directly calibrated in ohms. Slight rearrangement of the circuit permits the scale to be multiplied by 10, 100 or 1000 as required.

HIGH OHMS SCALES

Actually, it is often desirable to multiply the scale by 10,000 or 100,000, but, unfortunately, this requires extra batteries and is usually impractical in a portable instrument.

The various special resistors required by the circuit are best obtained from the meter manufacturer or from his representative. The accuracy of the instrument depends on the accuracy of the multipliers, so that ordinary 10 per cent or worse resistors which are quite adequate for most other purposes simply will not do.

The physical layout of the instrument, which can be seen from the photographs, is particularly straightforward. No attempt has been made to achieve ultra compactness. Smaller meters are obtainable, but we feel that the 4½in meter we have used is a very much better proposition than a 2in or 3in unit. The carrying case allows plenty of room for all components to be mounted so that they can be seen and also plenty of room for the batteries.

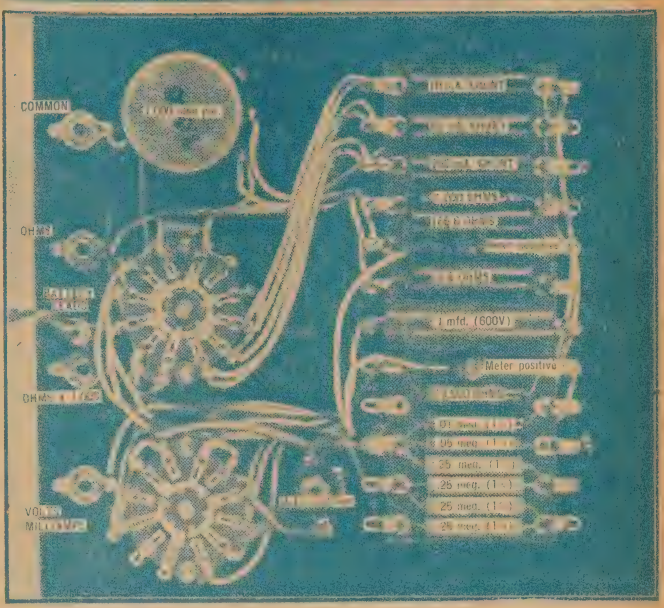
CONSTRUCTION

The panel is 7½in wide by 8in high, and cut from bakelite approx. 1-8in thick. It is, therefore, not necessary to insulate the tip-jacks or the Ohms scale compensating potentiometer. The panel is mounted flush with the top of the case, and the clearance between the back of the panel and the inside of the back of the case is 2 5-8in. Seven-eighths of an inch clearance is allowed inside the lid for the meter and control knobs.

Any handyman should be able to make quite a creditable job of the case, but factory-made cases, complete with leatherette covering handle, hinges, rubber feet, &c., should be available in the shops before you read this.

All resistors and the single .1 mfd. 600-volt condenser are mounted on

BEHIND MULTIMETER PANEL



This labelled photograph clearly identifies all major components.

a 6in length of resistor strip. The resistor strip is, in turn, mounted on the meter terminals. Apart from making all components easily accessible, this method makes it unnecessary to drill extra holes in the panel.

After the meter has been mounted on the panel, drill appropriate holes in the resistor strip and bolt it in place. Do not forget to include solder lugs under the terminal nuts. The shunts, multipliers, &c., can then be mounted on the panel. Make sure that all the leads are properly tinned so that there will be no difficulty in making a good solder joint later. You can twist the leads around tags on the strip to hold them firmly in place.

By the way, there are several types of resistor strip on the market, but choose the type which has silver-plated terminals as this type is very much easier to solder. The switch contacts will normally be silver-plated and it should not normally be necessary to use any flux other than the resin contained in solder. Should an excess of resin collect around any of the switch contacts, it can easily be flaked away when set and, in any case, has no harmful effects. However, paste flux is likely to cause leakages between contacts and is best avoided for this reason.

USE LOCK WASHERS

There are no special points to be considered in mounting the two switches and the potentiometer other than to position them for neat wiring. It is a good idea to include a lock washer under the mounting nuts so that they are not likely to work loose in use. The same applies to the four tip jacks which should also have a tinned solder lug under each.

The rectifier is mounted on a small bracket made from scrap aluminium. The bracket is fixed by one of the meter-mounting screws, the object being to avoid drilling an extra hole in the bakelite panel.

With all the components mounted you can proceed with the wiring job. We found it convenient to use plastic-covered hook-up wire, but there is no reason why belden or any of the other types of hook-up wire could not be used. Short leads are desirable, of course, but in an instrument of this type the primary aim should be neatness so that it can be easily serviced.

THE RECTIFIER

The rectifier will normally come from the manufacturer with leads about two or three inches long attached. They are usually identified by means of a color code. The rectifier elements are easily damaged by heat, and we would recommend that the leads not be cut shorter than about one inch so that the heat transferred to them through the wires is minimised. Lengths of spaghetti insulation can be used to prevent accidental short-circuit.

The method of wiring the shunt resistors requires some attention. We have drawn the circuit in such a way as to suggest the desirable method. Note that two wires go from the switched end of each of the three shunts to the upper and lower

(Continued on Page 70)

Goldring

PICKUP RANGE SEPTEMBER 1950

THE WORLD'S MOST COMPREHENSIVE RANGE OF PICKUPS

EVERY MODEL THE BEST IN ITS FIELD

HEADMASTER PICKUPS

Type	Output	Frequency Range	Stylus	Particulars	Price
					£ s d
Supplied with: 1 Cartridge Arm 12". 1 each Cartridge Green Red Orange Tonaliser C Multi-Ratio Transformer	45 millivolt 250 millivolt with transformer.	30-18000	Sapphire	Highest quality reproduction of all records. Interchangeable cartridges with sapphire points of correct dimensions. Easy & quick operation of plug-in cartridge. Recognised by experts as the best & cheapest Pickup on the market. COMPLETE	10/14/6
				Available separately. Cartridge Arm (12") Cartridge Arm (16") Cartridge—Green (Standard) Cartridge—Red (Wide range) Cartridge—Orange (Old recordings) Cartridge—Yellow (Microgroove) Transformer Tonaliser	1/8/6 1/19/6 1/8/6 1/8/6 1/8/6 1/15/0 2/6/9 2/16/0

THREE-WAY PICKUPS

Type	Output	Frequency Range	Stylus	Particulars	Price
					£ s d
150	150 millivolt	30-16000	Sapphire Stylus	Especially designed to give high-fidelity reproduction of all types of records. Plays standard 78 revs. as well as long-playing (Microgroove) Records (33 1-3 & 45 revs.). Incorporating the Magnetic Cartridge. No. 150. Weight adjustment. Supplied with two styli: BLUE for standard and YELLOW for long-playing records. Beautiful Polystyrene Mouldings.	6/7/6

LIGHTWEIGHT PICKUPS

Type	Output	Frequency Range	Stylus	Particulars	Price
					£ s d
122	.25 Volt	30-8000	Replaceable Sapphire	High Output. Medium frequency range. Ideal for use with standard receivers. Low needle pressure minimising record wear. Finished in florentine bronze.	3/13/10
123 (MAGNA)	.25 Volt	30-8000	Replaceable Sapphire	As above, but with one Interchangeable Cartridge. Ideal for Commercial or P.A. equipment with quick needle changing or replacement essential.	3/13/10
125	.25 Volt	30-7000	Standard Needles	The Lightweight P.U. using standard size Sapphire, steel or thorn needles.	2/17/-

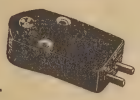
AUTO-STOP PICKUPS

Type	Output	Frequency Range	Stylus	Particulars	Price £ s d
137A	.7 Volt	40-6000	Standard Needles	An amazing new feature: The automatic start-stop device incorporated in the base. This makes it the ideal replacement pickup for any old or heavy pickup (magnetic or cystal). Maximum output in minimum of space. Needle pressure only 40 grams. Beautiful Polystyrene Mouldings.	4/0/0

BANTAM PICKUPS

Type	Output	Frequency Range	Stylus	Particulars	Price £ s d
130	.3 Volt	40-7000	Standard Needles	Inexpensive, sturdy, reliable. Really good value.	2/1/2

MAGNETIC CARTRIDGE To replace CRYSTAL CARTRIDGES



Type	Output	Frequency Range	Stylus	Particulars	Price £ s d
150/CARTRIDGE	150 Millivolt.	30-16000	Sapphire Stylus	High fidelity cartridge, fitting most crystal pickups of American, Australian and U.K. manufacture. Supplied with Blue stylus for standard and Yellow stylus for long-playing records. Easy to fit. As incorporated in three-way pickup.	3/3/0

REPLACEMENT HEADS FOR GARRARD CHANGER

Type	Output	Frequency Range	Stylus	Particulars	Price £ s d
G.1	.25 Volt	30-8000	Replaceable Sapphire	Owners of Garrard Changers from R.C.4 to R.C.70, can easily and without skill IMPROVE their reproduction and preserve their records by using this Lightweight Head. Low needle pressure and all other advantages of Lightweight Pickups. Not suitable for RC 65A or RC 70A.	2/15/9
G.2	.25 Volt	30-7000	Standard Needles	As above, but using standard size Sapphire, steel or thorn Needles. Low needle pressure and most advantages of Light weight Pickups.	2/5/3

PICKUP HEADS

Type	Output	Frequency Range	Stylus	Particulars	Price £ s d
112	.3 Volt	45-5000	Standard Needles	Convert your Portable Gramophone into a Record Player simply by connecting the Pickup Head to the Wireless Set.	1/13/4
112/IVORY	.3 Volt	45-5000	Standard Needles	As above, Ivory finish.	1/15/1

Leaflets giving full TECHNICAL INFORMATION, Frequency Response, Curves of every Pickup, etc., are available on request from your supplier, and from:

GOLDRING ENGINEERING (A/SIA) PTY. LTD, 57 H.E. AREA, ST. MARY'S, N.S.W.
Phone: St. Mary's 447. After Business Hours, UW6907.

BUILDING A STANDARD MULTIMETER

(Continued from Page 67)

banks of the eleven-position switch respectively. As you can easily work out for yourself, the same connections could be achieved by wiring the upper and lower banks of the switch directly together and then running a single lead to each of the shunts. However, if this were done, each of the leads would be effectively in series with its respective shunt.

The same principle is employed in wiring the unswitched side of the shunts. A lead is run from the tip-jack to the shunts and a second lead from the shunts back to the three-position switch.

We admit that the error introduced by not following these wiring precautions would be very small indeed with hook-up wire of normally low resistance, but nobody is likely to object to installing the extra four wires involved.

By the way, the switching system in the meter is so arranged that the effects of contact resistance in the switch are minimised.

BATTERY LEADS

The batteries for the ohms ranges are mounted in the back of the case, and it will be necessary to install three leads to make the necessary connections to them. We suggest that the leads be firmly anchored to the panel to prevent the wiring being disturbed when the instrument is removed from the case. A small clip for this purpose can be made from a piece of scrap metal and mounted under one of the tip-jacks. Wrap the battery leads with insulating tape before bending the clip to grip the leads, so that there is no possibility of a short-circuit.

Naturally, before you consider the instrument complete you will wish to compare all the ranges with an instrument known to be accurate. However, before doing this, it is a good plan to roughly check all the ranges to make sure that the wiring is correct. An ordinary a-c operated receiver will be of assistance in this matter.

TESTING

Switch the set on and allow it to warm up. Select the 1000-volt d-c range and place the test prods across the cathode bias resistor of the output valve or the back bias resistor, as the case may be. The meter should give a very slight deflection. Switch to the 250 and 50 volt ranges in turn, and the meter should give increasingly higher readings. The 10-volt range may be roughly checked across a cathode bias resistor for one of the RF or IF stages, or alternatively a torch battery.

Similarly, the a-c ranges can be checked using a convenient filament winding.

Switch to each of the ohms ranges in turn and make sure that, with the test leads shorted, the zero adjuster will bring the meter to exactly FSD. A few checks with resistors of known value will serve to determine if each range is reading correctly.

In making all these tests, be prepared to disconnect the meter quickly should the needle go hard over past full scale or bang against the stop in the reverse direction, indicating an error in the wiring or a faulty multiplier or shunt.

PANEL MARKING

Having carefully assembled and wired the instrument, you will probably not be satisfied to have the positions of the controls indicated by sundry scratches or pencil marks on the panel.

If circumstances permit nothing better, the scale can be marked on a piece of good quality card with Indian ink and mounted under the control locking nuts. However, for a few shillings a jeweller will engrave the panel and the engraving can be filled with white enamel, making a very attractive and easy-to-read panel.

Even if you decide later on to invest in more advanced test instruments, your multimeter will always be one of the most useful and versatile on your test bench, and extra care in carefully constructing and finishing it will be well repaid.

WHO REALLY DISCOVERED ATOMIC ENERGY?

ALTHOUGH atomic energy has been very much in the limelight since the bombing of Hiroshima and Nagasaki, it is by no means a new scientific subject, for experiments have been going on in various parts of the world for more than 100 years.

For many centuries scientists have endeavored to discover methods of transmuting the elements. The alchemists endeavored to find methods of changing the atomic structure of base metals, and to turn them into gold, in other words, methods of making one element into another. Mendeleef discovered the periodic law of atomic structures and graded the elements in the order of valency.

His table showed that there was a common order and gaps in this order indicated that there were missing links, most of which have since been discovered, plutonium being the latest.

THE ELEMENTS

The elements arranged according to their atomic numbers start off with hydrogen, which is No. 1, and in numerical order there follow: helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon, sodium, magnesium, aluminium, silicon, phosphorous, sulphur, chlorine, argon, potassium, calcium, scandium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc, gallium, germanium, arsenic, selenium, bromine, krypton, rubidium, strontium, yttrium zirconium, niobium, molybdenum, ruthenium, rhodium, palladium, silver, cadmium, indium, tin, antimony, tellurium, iodine, xenon, caesium, barium, lanthanum, cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutecium, hafnium, tantalum, tungsten, osmium, iridium, platinum, gold, mercury, thallium, lead, bismuth, polonium, niton, radium, thorium, protoactinium and uranium.

These elements may be arranged in order of valence or valency, which is a property possessed by elements or radicals of combining with or replacing other elements or radicals in definite and constant proportions. Thus valency is the degree of this property, commonly indicated by the number of monad elements, represented by hydrogen, with which the atom or radical can combine or which it can replace. It, of course, varies with different elements.

COMBINATION

Thus hydrogen has a valence of 1 and is called a monad; oxygen has a valence of 2 and is called a dyad; bismuth has a valence of 3 and is called a triad; carbon has a valence of 4 and is called a tetrad. Certain elements have more than one valence; tin, iron and sulphur, for example. Rearranging the elements we find that they group themselves into monovalents, divalents, trivalents, tetravalents pentavalents, hexavalents, &c.

It is not surprising that various countries are claiming the credit for atomic energy, but investigation will show that beyond all doubt it is due to Great Britain alone. It was John Doulton, an Englishman, who first expounded the idea of atomic structure of matter, but it was the work of Clerk Maxwell, who toward the end of the last century propounded the mathematical basis for the theory of high-speed particles emitted by atoms, which really set the scientific world to work.

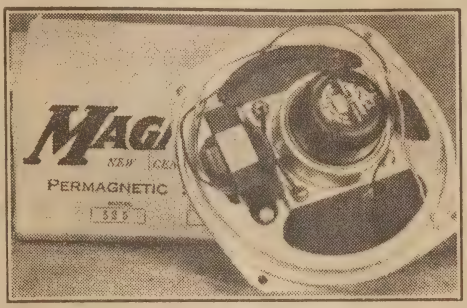
J. J. Thompson, in 1898, carried the work of Maxwell further by propounding the idea that the atom was made up of electrons. Later Professor Einstein produced the equation relating mass to energy, and it is upon this equation, first published in 1905, that the principle of atomic energy rests. It was not until the end of the first world war that Lord Rutherford, at the Cavendish Laboratory, Cambridge, conducted his famous experiments in splitting the atom.

—F. J. Camm, in Practical Mechanics.

TRADE REVIEWS AND RELEASES

MAGNAVOX SPEAKER—MODEL 525

Latest addition to the Magnavox "Centre Pole" series is the model 525 illustrated below. Intended for mantel and portable receivers, it has a 5¼-inch cone and a housing that is comparable in overall dimensions to standard 5-inch types.



SPECIAL feature of "Centre Pole" series is that the complete permanent magnet structure is removable, thereby simplifying and cheapening cone repairs, &c.

The speaker has a ¾in diameter voice coil with a nominal impedance of 2.7 ohms —a standard figure for all Magnavox speakers. The main cone resonance is quoted as 120 c/s but it is well damped and cone movement is smooth down to at least 50 c/s. At the top end, and with the standard midget transformer in circuit, the response is well sustained to 4000 c/s, sensitivity is excellent.

Retail price for the model 525 is quoted as 33/8.

Interstate distributors for Magnavox products are as follow: Brisbane Irvines Ltd. and Edgar V. Hudson Ltd., Sydney. George Brown & Co., Pty. Ltd., John Martin Pty. Ltd. and Bloch & Gerber Ltd., Melbourne, Warburton Franki, Melbourne, Ltd. Adelaide, Gladiola Co., Perth, Ronfred & Co.

(Magnavox Pty. Ltd., 61 Dowling St., East Sydney, NSW.)

MANLEY ROTO-TRIMMER

Latest release by Amplion (A'sia) Pty. Ltd. is the Manley Roto-Trimmer—a labor saving device for the professional or home gardener.

THE ROTO-TRIMMER is designed to make light work of the tedious task of cutting lawn edges and other inaccessible spots where it is impossible to use the normal type of mower.

An enclosed electric motor spins a high speed cutting blade past a coarse "comb," as seen in the accompanying close-up photograph.

The motor operates at 32 volts for complete safety. For a-c operation it is powered from a step-down transformer, while a mobile battery can be used as an alternative where power is not available. Power consumption is approximately 130 watts.

Retail price of the Roto-Trimmer is £22/10/- exclusive of the transformer or battery. It is available on immediate delivery. (Amplion (A/'sia.) Pty. Ltd., 36-40 Parramatta Road, Camperdown, NSW).

Book Review

"SCREW THREADING AND SCREW CUTTING" by "DUPLEX." Paper cover, 88 pages, Australian price 5/6 approx. plus postage.

Plenty of clear, easily understood diagrams are used to assist the presentation of this little book, which contains a great deal of practical workshop information.

Chapter 1, deals with the various types of screw threads giving their specifications and particular uses. It goes on to discuss the use of the thread tables.

The remaining five chapters emphasise the practical aspect of screw threading methods and screw threading equipment, plenty of illustrations from actual projects being given. Tables of standard threads with clearance and tapping drill sizes are included in the appendix. They cover most of the British, American and Metric threads likely to be met.

"IN THE WORKSHOP" Volume 2, also by "DUPLEX," hard cloth cover, 151 pages Australian price 13/3 approx. plus postage.

This volume is also a practical workshop guide being a selection of articles from "The Model Engineer." Detailed descriptions of the construction of a number of useful workshop devices are given, together with informatiion on the use of a number of hand and machine tools. Two of the nine chapters deal with Lathe Filing-rests and an Auxiliary Bench Vyce respectively while one chapter is devoted to Hacksaws and Hacksawing.

(Our copies of both books from the publishers, Percival Marshall and Co., Ltd., 23 Great Queen St., London WC2.).

CHANGE OF NAME

TO be more in keeping with the nature of current activities, Radio Equipment Pty. Ltd. is now operating under a new name— "University Graham Instrument Co." Located at 5 North York Street, Sydney, the firm specialises in the manufacture of radio and electrical test equipment.

OTHER ITEMS OF INTEREST:

● A new catalogue is available from the Aegis Manufacturing Company, listing in attractive fashion, their current lines. The catalogue illustrates and lists the various coils, coil kits, I.F. transformers, foundation kits and sundry other small items. Of special interest is mention of a projected push-button tuner. The catalogues are available for the cost of the postage, amounting to 9d. (Postal address: 208 Lit. Londsdale St., Melbourne, C1.).

● Messrs. J. H. Magrath and Co., advise that a new Super Lightweight Connoisseur pickup is available which features three interchangeable heads for standard and microgroove recordings. Needle point pressure is quoted as 10/12 grams for standard records and 5/7 grams for microgroove discs. The frequency range is stated to be 25-15000 c/s within plus or minus 2db., A 25 ohm model gives 10 mV. output direct or 300 mV. from a step-up transformer. A 400 ohm model is also available. (J. H. Magrath, 208 Little Lonsdale St., Melbourne, C1.).

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Fit this 5-Valve Receiver to any model car

Chrome aerial extra depending on type of car.

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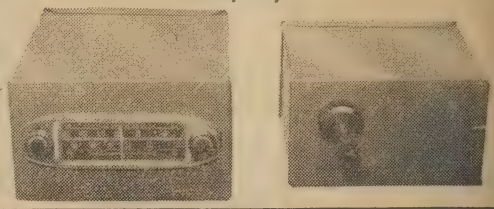

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Battery Charger Kit. Homecrafts 6 volt 4 amp. Battery Charger Kit. Kit includes 6 volt 4 amp. English Selenium Rectifier, transformer, black crackle finish metal case, 2 terminals and hook-up wire. Complete kit, as illustrated, only £4/10/-. 12 volt 2 amp. Kit, 5/- extra.

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"Collaro" Rim Drive Electric (A.C.) Gramo motor, complete with Crystal Pick-up, £6/-/-. Above Motor, complete with Magnetic Pick-up, £5/8/6.

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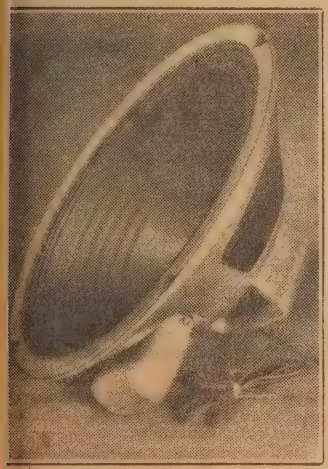
M.S.P. JENSEN LOUDSPEAKERS

A special agreement between Manufacturers Special Products Pty. Ltd. and the Jensen Company of America has resulted in the release on the Australian market of speakers carrying the well known "Jensen" label.

THE speaker illustrated below is referred to as M.S.P. Jensen type 12P36. It is nominally a 12" unit and requires a baffle hole of 11" diameter. Overall depth is 6". These speakers incorporate for the first time a special "Hawley" cone and an improved dust-proof "breathing" type suspension. Properly baffled, they are credited with a power handling capacity of 15 watts, mak-



ng them suitable for use in large console receivers or multiple-speaker amplifier systems.

An Alcomax 11 magnet is employed in a special magnetic circuit giving a flux density in the air gap of 10,000 gauss. All steel parts are cadmium plated and the transformer is a wax-immersed insulated core type.

For purposes of identification, the speakers are sold under a composite type, number which indicates both the speaker type and the transformer impedance. Thus type AU50-12P36 is a 12P36 speaker fitted with a 5,000 ohm transformer.

Voice coil impedance is 6.5 ohms and a variety of transformers are available to meet differing load requirements. The speaker retails for £7/6 complete with a "single-ended" transformer, or for 70/- with a push-pull or line transformer fitted.

Main cone resonance is quoted as 77 c/s but samples submitted for test averaged nearer 100 c/s. At the top end, the response appeared to hold up well to about 5 kc., with a gradual taper thereafter.

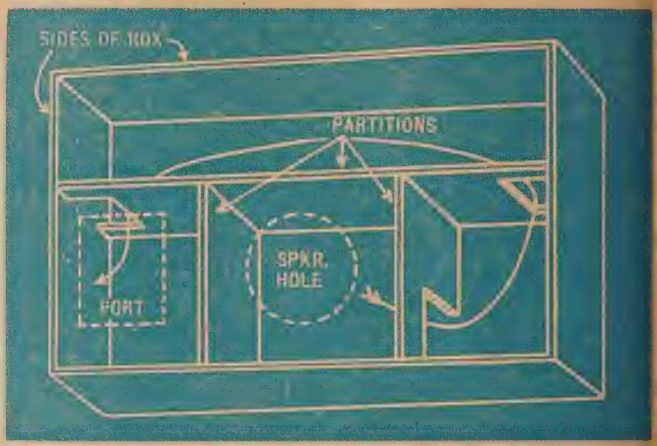
Jensen speakers are handled by Trade Houses throughout the Commonwealth. Trade enquiries to Manufacturers Special Products Pty. Ltd., 47 York St., Sydney.

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

BETTER BASS FROM RADIOGRAM CABINET

Many readers, desiring better bass response, find they have not the room to accomodate a vented enclosure, either inside or outside the normal cabinet. Mr. I. W. Emmerson, of 17 Frederick St., Concord, NSW, describes a system of partitions which, when added to his cabinet, gave a worthwhile improvement in results.



MR. EMMERSON purchased the cabinet, which was found to be quite well built, but not very successful as a baffle. This was due in part to a light baffle board and also to the natural limitations of any open-backed cabinet. Results fell far short of those obtained from a vented enclosure, which however, could not conveniently be located in the room, in addition to the cabinet.

Accordingly the first step was to install in the cabinet a large baffle board made up from solid stock and over an inch thick. Excellent timber for this purpose can be obtained from large packing cases, particularly those coming from European ports.

NEW BAFFLE

Addition of the heavier baffle improved matters somewhat but the results were still not acceptable, or at least not to be compared with those obtained using an enclosure.

Measurement of the cabinet showed that nearly eight cubic feet of space was available but a good deal of this would be required to house the amplifier, the tuner, the record players, record compartment and so on. Allowing also for the bulk of any damping material which might be included, there was just not enough room for an adequate built-in vented enclosure.

Accordingly, a different approach altogether was adopted, aimed at leading the back wave from the speaker through a longer and more heavily damped return path, thereby lessening its interference with direct radiation from the front of the cone. The nature and position of the baffle plates was simply intended to satisfy this basic idea, rather than to satisfy any particular design data.

Whether by good luck or good management, the net result is much more acceptable than that originally obtained from the untreated cabinet.

The exact procedure for the construction will vary with the materials and facilities available but Mr. Emmerson built the complete speaker housing as a unit which was then fitted into the cabinet.

The timber used throughout was 1 1-8in pine which was solidly braced and all permanent joints sealed with gasket cement and made firm with long nails. The removeable bottom panel was sealed with felt and attached by means of long screws. The assembly as a whole is thus substantially airtight, except for the designed return path, and it is a tight fit inside the cabinet. Screws and steel brackets hold it firmly in place.

VENT AREA

All vents were made equal to 0.8 of the speaker cone opening—a figure suggested by specifications for vented enclosures.

On test, with a signal supplied from a frequency disc, Mr. Emmerson reports the response as being smooth down to 70 c/s. which is the approximate cone resonance of the 12in speaker used. It tapered gradually to 50 c/s, then fell away sharply to 35 c/s. While this is not as good as can be expected from a heavy speaker in an adequate baffle, it showed up as a marked improvement on the open-backed cabinet arrangement.

Incidentally, it was found desirable to remove a "tone control" condenser from the plate of the qutput valve in the set to improve the high frequencies and give a better overall balance to the reproduction. Extended bass, with severely limited high notes tends to give a rather muffled result.

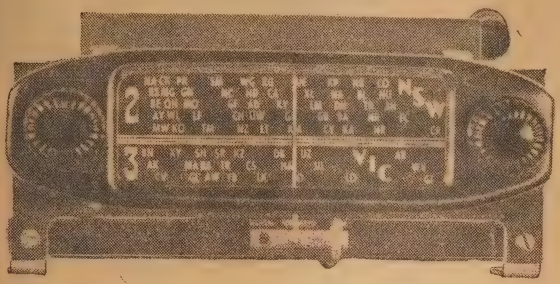
The outside dimensions of the original box measured 28in x 14in x 20in but these figures have no special significance apart from the fact that they worked in with the original cabinet.

EXPERIMENTS

For readers who may care to experiment along these lines, the idea behind the suggestion is basically to lengthen the return path for the sound waves from the rear to the front of the cone. While it helps to keep the path as long as possible, the cross sectional area of the path at any point should not be less than the cone area, otherwise it will tend to resonate the sound waves inside the inner compartments only.

Some acoustic damping may be an advantage, particularly in the inner compartments.

If the sides of the cabinet are of at least ¾in timber, they could serve as the sides of the box.



MSL-48

Available with calibrated scale as shown, or marked in kilocycles for car radios.

With calibrated scale this dial is very suitable for use with new miniature valves, for use in very small mantel receivers. It has an attractive two colour scale.

The escutcheon is cast brass, and is available in florentine bronze or satin chrome finish.

Overall Dimensions: 5½in. x 2½in.

Escutcheon: Vision 3 3-8in. x 1 1-8.

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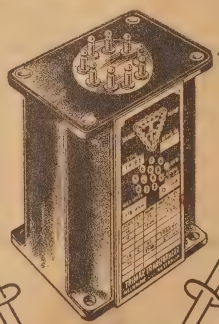

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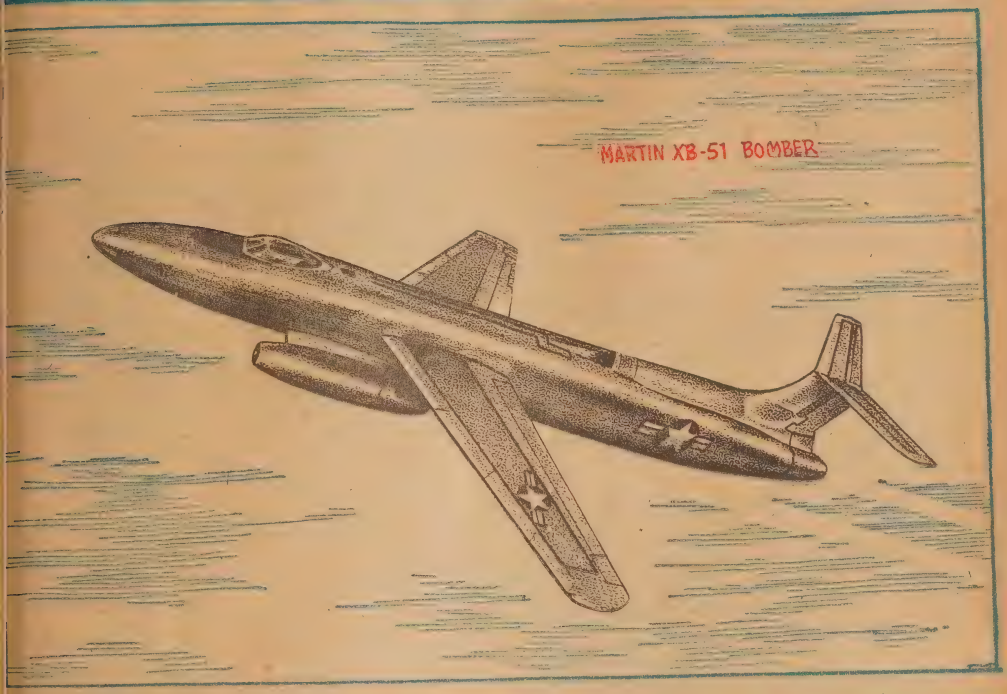

Described by its builders as "the US Air Force's first postwar plane specifically designed for supporting ground forces," the Martin XB-51 is a three-jet bomber of sleek outline. Following the design style that has been set for high-speed jet combat aircraft, the XB-51 features wings which are drastically backswept. Of thin section, the wings spring from the fuselage about half-way along its length and in slightly higher than mid-wing position.

ONE of the main roles visualised for the aircraft is that of hampering enemy supply lines and installations. It is a versatile machine, however, and is capable of very high speeds as well as having high manoeuvrability, so that it should not find itself at a disadvantage in air combat.

Power comes from three jets, one mounted on a pylon on each side just out from the base of the fuselage, and the third in the tail. The intake for the fuselage jet is on the top of the fuselage forward of the tail root. The outlet is in the extreme tail.

T-SHAPED TAIL

This arrangement has made necessary a specially-designed T-shaped tail unit, with tailplanes mounted on the top of the fin and showing slight dihedral.

Another feature that has been revealed is tandem landing-gear. Many other installations on the XB-51 are still secret, however.

The designers, the Glenn L. Martin Company, of Baltimore, have stated that the XB-51 represents the product of co-ordinated studies by the firm's engineering team covering electronic, aerodynamic, metallurgical research, and servo-mechanism experts.

The great surge of power available from the three jet motors cuts the takeoff runs, and faster starts would make it possible for the XB-51 to be operated from small combat-area fields.

To cut down landing run, the aircraft has a great parachute stowed aft which may be released at the pilot's discretion. This form of parachute brake had already been tried successfully on Boeing's Stratojet B-47.

Little has yet been heard of the XB-51, but it is clearly an aircraft destined to play a specialised and important role in the US Air Force's programme of preparedness.

It is one of the new pacemakers of military aircraft.

Turbo-prop Convair

CONSOLIDATED VULTEE are almost ready with their new turbo-prop Convair. Almost identical with the 40-passenger Convairs now long in service except for the power plant, it will be equipped with two of the new Allison T-38 twin turbo-prop engines. Old Convairs can be easily fitted with the new engines.

The engine is said to be the most powerful propellor-type engine ever cleared for flight. It develops two horsepower per pound of weight.

Turbo-prop planes have a permanent place in the future, LaMotte T. Cohu, president of Convair, recently declared. They are the logical step in airline progress because the vast public investment in airports, airways and traffic control systems is geared to propellor-driven planes. The new planes will fit neatly into today's traffic pattern because fuel economy is such that planes can carry ample reserves to meet government requirements.

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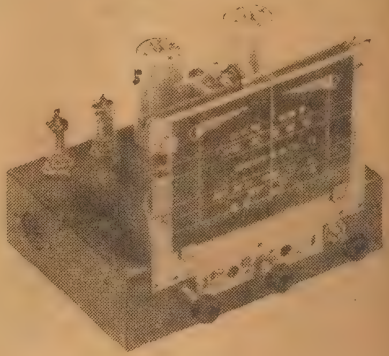

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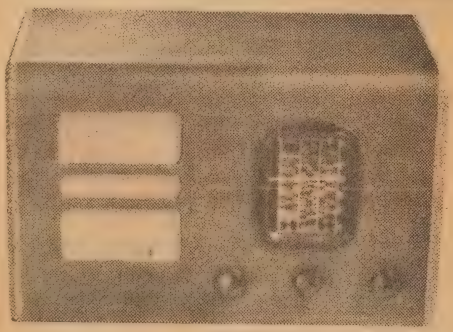

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RADIO CONTROL OF MODEL AIRCRAFT

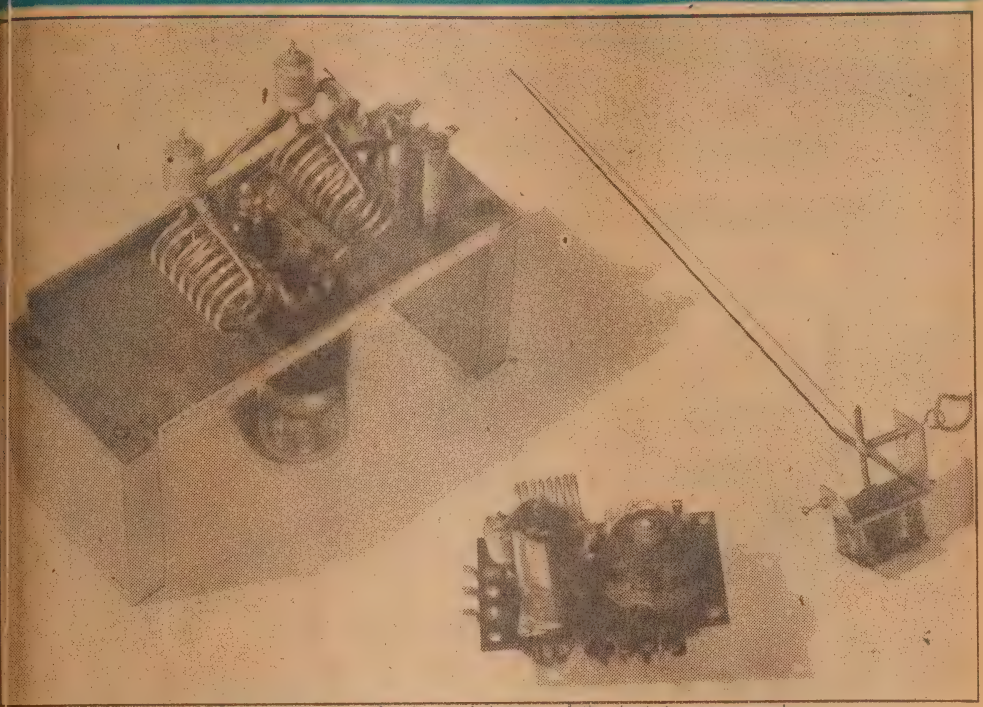

Fig. 4.—Transmitter, Receiver and Actuator of the simplest sequence system.

The author of this most comprehensive series of articles has been engaged for some time in radio control investigation for the CSIRO's Radiophysics Division and is well qualified to discuss all its aspects. The articles have particular value in that the same general principles are applicable to many types of models.

by GIL MILES

RADIO control of model aircraft is an absorbing subject, and apart from the fact that remotely-controlled models are used as targets for gunnery practice and for aerodynamic and meteorological research, the experienced aeromodeller can with comparatively simple equipment, enjoy this fascinating extension to his hobby.

EARLY HISTORY

Claims over the years have been many, but it is generally agreed by competent observers that 1937 saw the first successful application of radio control by the Americans during their National Model Airplane Competition that year. Strangely enough, it was an Australian radio amateur, the late Ross Hull, then resident in America, who introduced the rubber drivers' escapement, an extra lightweight control device which contributed much to the success of that time, and today his device is still considered highly satisfactory for preliminary work.

In latter years, of course, the availability of miniature valves, motors and components, plus new control techniques developed during and since the war, have emphasised further the possibilities of very small and reliable equipment. From inquiries already received, it is evident that the radio amateur and the aeromodeller are both very interested, in what is to us, in this country, something new.

RADIO KNOWLEDGE

It would be true to say that it takes radio people to build radio gear and aeromodellers to build successful flying models. As each will need the other for technical assistance, members of both hobbies should get together for their mutual benefit, for successful radio control will require our very best efforts.

Although almost every other country is using different transmitter frequencies and input powers, the conditions for Australia have been very definitely laid down by the Wireless Branch of the Postmaster-General's Department, and it is strongly advised that intending experimenters obtain the necessary permit to operate.

THE MODELS

As this is a discussion of the radio requirements of controlled flight, the model will be dismissed by saying that it must of course be capable of lifting the radio equipment, and should have already proved itself a stable flyer. Most models have sufficient stability built in, and are trimmed to climb under power and glide with the engine off, therefore rudder movement alone will provide directional control, which, after all, is the

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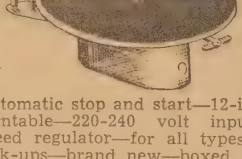

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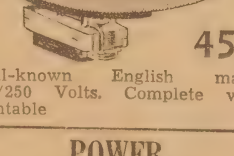

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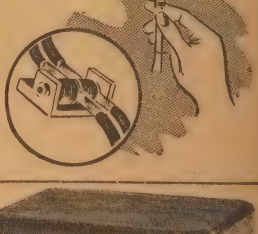

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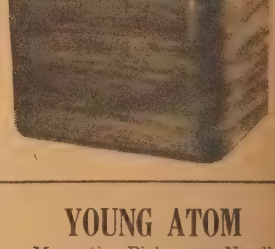

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mary purpose of adding radio con-
.
lodels from 5ft to 10ft wing span
indicated, as wing spans under
tend to produce a flit rather than a
ht.
tudder control easily tops the list
what to control, with engine speed
cut off next. Ailerons can also be
d to produce a turn, but they are
as easy aerodynamically or
chanically to set up as a rudder,
will be placed third on this list.
Fourth and last are the elevators.
less very precise and instantan-
is control is available, elevator
trol is a danger, particularly when
model is near the ground.
The fact that radio can be made
lower wheels, flaps, and work
ny other gadgets is of secondary
portance to the newcomer, and
ually leads to complicated ar-
igements which do not necessarily
tribute anything worthwhile.
This article, then, is intended as a
y brief review, rather than a com-
hensive survey of equipment used
er the years, with a look at most of
known control systems, as well as
description of some experimental
ar made by the author over the last
o years.

ESSENTIAL PARTS

Any radio control system can be
duced to three essential parts, the
nsmitter, usually on the ground,
nich radiates the control signals,
d in the model, the **receiver**, which
cks up the signal and passes it on
the **actuator**, which does the re-
ired work, such as moving a con-
ol surface, changing the engine
eed, and so on.
The equipment used by the early
perimenters certainly showed a
riety of ideas. Transmitter powers
nged from 5 watts to 50 watts, and
equencies anywhere between 3 mc/s
d 60 mc/s.
Some very elaborate set-ups have
peared using telephone dial type
ntrol boxes on the ground, and
mplicated selector switches in the
odel.
In one case up to four transmitters
d receivers were used, one for each
ntrol function. They all had the
me idea, however, and that was to
erate a sensitive relay in the
odel's receiver, whenever the con-
ol signal was transmitted. The re-
y contacts usually connected into
rcuit some form of escapement,
ther rubber or motor driven, to
ove the control surfacer.

RECEIVER

The receiver operating on 3 mc/s
ed the well-known oscillating de-
ctor. With the transmitter "on,"
ie resultant audio beat note from
ie detector was passed through an
mplifier valve to an over-biased
lay valve, the increase in anode
rrent with signal, closing the con-
ol relay.
This method of detection proved
nstable, so the super-regenerative
etector, known for its extreme sen-
tivity and having other advantages
or this work, made its appearance,
nd has formed the basis for most
eceiving systems since.
The super regenerative method of

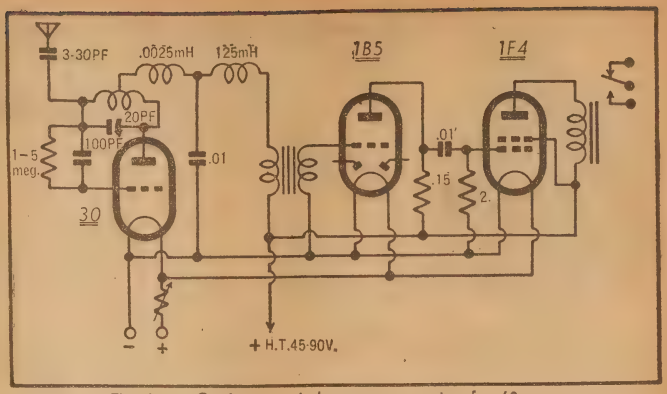

Fig. 1. — Carrier operated super-regenerator for 60 mc.

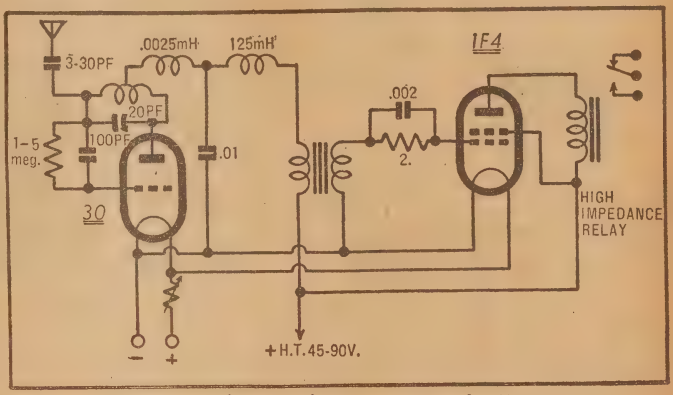

Fig. 2. — Tone operated super-regenerator for 60 mc.

detection produces a large quench or, as it is commonly called, "hiss" voltage, which can be heard if a pair of headphones are connected into circuit.

In the early receiver circuit shown in fig. 1, the hiss voltage is used for control purposes. Amplified, it is used to bias the following relay valve to minimum anode current. With an incoming signal (transmitter on), the hiss stops and the relay valve anode current seeks its static value, the resultant current change operating the relay.

Another early system made use of an audio tone, as modulation of the carrier for control purposes. The receiver used with this type of transmission is shown in fig. 2. It consists of a super regenerative detector followed by a relay valve, the rectification of the modulation by the relay valve, providing the required anode current change.

The simplest radio control system used today still makes use of the super regenerative detector, but the relay is connected directly in its anode circuit. Adjustments are such that, with the detector valve idling (carrier off), the anode current is sufficient to hold the relay closed. With the transmitter "on," however, the detector anode current can be made to drop as much as 2.0 mA, allowing a held-up relay to drop out.

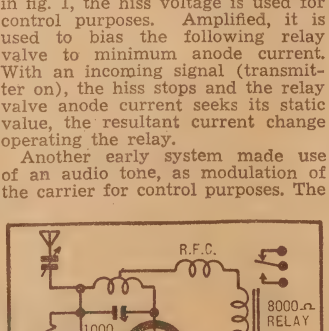

Fig. 3. — Thyratron self quenching detector.

SPECIAL VALVES

The Raytheon Valve Co. of America developed many years ago the RK62 especially for radio control; a minature version, the RK61, is a later edition. A circuit diagram using either of these valves is shown in fig. 3.

An English sub-miniature valve, the Hivac XF91, with similar characteristics to the two Raytheon valves, has just made its appearance.

Known as gas triodes or thyratons, sufficient anode load must be used to limit the anode current to not more than 2.0 mA.

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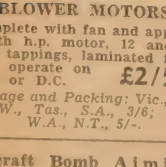

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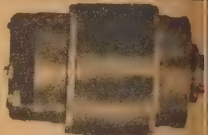

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ignal, the circuit is oscillating at oth radio and audio frequency. When the RF control signal is received, the AF oscillation stops, with sudden decrease in anode current rom 2.0 mA to approx. 0.5 mA The hotograph of fig. 4 shows the three nits that go to make up the simlest control system, the transmitter, receiver and actuator.

This particular transmitter, with ts circuit of fig. 5, uses a pair of Q5-GT valves arranged in a push-ull, tuned-plate, tuned-grid circuit, with component valves for operting in the 40.66 to 40.7 mc/s band. The filaments are supplied from a ingle No. 6 dry cell and high tenion from 135 volts of heavy duty "B" batteries.

Connected to a suitable antenna, t will provide a workable signal ver half a mile at ground level; his distance increases, of course, with the model in the air.

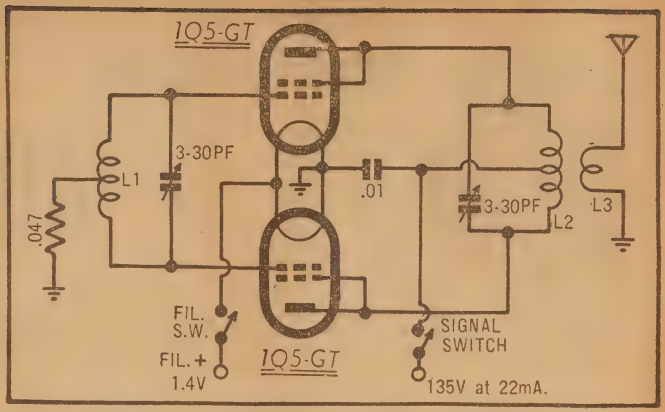


Fig. 5. — Battery operated transmitter for 40 mc. L1 and L2 have 8 turns of 16 gauge, ¼ inch diameter, centre tapped. L3 has one or two turns.

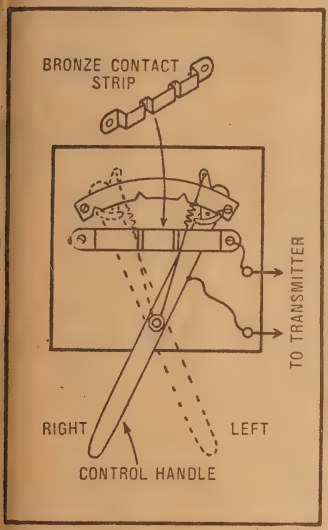


Fig. 6. — Bourne type control stick.

This system is known as "on-off" sequence control and its operation is based on the transmission of a series of pulses. With the actuator connected to the model's rudder, the first pulse or dash turns the rudder from neutral to, say, right, the next pulse back to neutral, the next left, and the next back to neutral, and so on, in a definite sequence.

It might seem, at first glance, that the continuous cycle complicates and delays the control function, but in practice this is not so. The operations can be performed so rapidly, if necessary, that the rudder can go "through" a position without the model responding. Any sort of switch can be used to switch the transmitter on and off as control signals are required.

A telephone type switch that has been rebuilt so that contact is made and broken (sending a dash) as the switch is moved from centre or neutral to either extreme position is quite satisfactory. Experience has shown that it is not always possible to remember just what the next position of the rudder is going to be, so, to avoid confusion, the "Bourne" type control was developed.

Shown in fig. 6, this control stick has three positions, neutral, right and left. The centre arm makes momentary contact as it is moved from one position to the next; it always moves in the "right" direction and at the same time it points in the direction of the turn.

OLD TIMER

The single-valve receiver using the circuit shown in fig. 7 is another old-timer, but still good. Miniature valve types 3S4 or 3V4, triode connected, will work satisfactorily. It has been found that the use of separate quench oscillator coils give superior results to the usual method of juggling the grid capacitor, grid resistor combination to make the detector valve super regenerate. A separate valve or the second half of a twin triode used as the quench oscillator allows the detecting and quenching condition to be individually adjusted with an overall gain in operation. A suitable design of quench coil is shown in detail in fig. 8.

An antenna of doublet dimensions if the model is large enough, or a single wire a few feet long can be directly, capacitively, or inductively coupled to the coil. In order to achieve the large anode current charge with transmitter on or off that is required to operate the relay, the antenna length and coupling, and the grid resistor valve are the important adjustments with these receivers.

An idling current of 5.0mA, with a drop to 3.5 or 3.0mA is possible when everything is working properly.

Although the relay cannot be seen in fig. 4, it is the same type as shown in fig. 32. These relays are ex-disposals stock, and are found in the receiver section of the SCR-522-A communication set. The coil has a DC

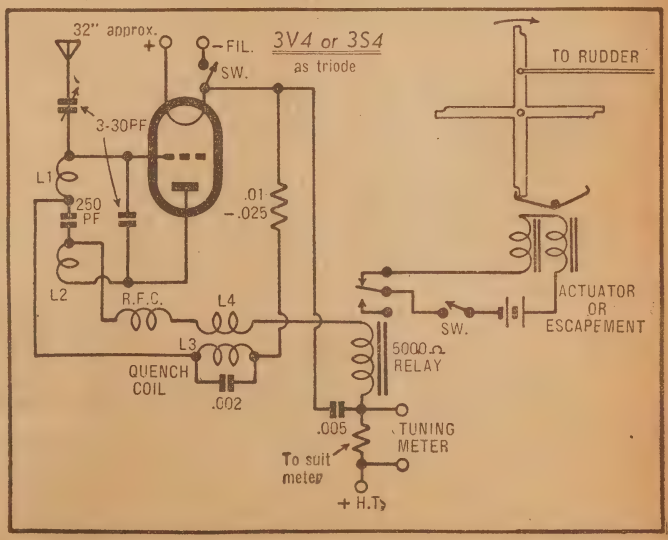
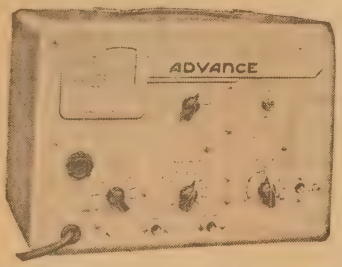


Fig. 7. — Receiver and actuator for 40 mc. L1 and L2 have 5 turns of 16 gauge wire, ¼ inch diameter. L3 and L4 comprise a 30 Kc. quench coil.

SIGNAL GENERATORS



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An illuminated directly calibrated dial with a scale length of over 30" is provided and this is easily and accurately set by means of a slow motion control with a reduction ratio of 10-1.

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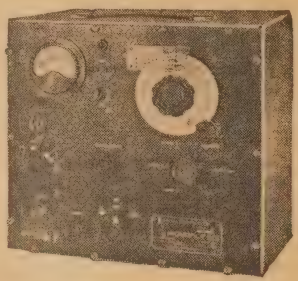

A SUB-STANDARD SIGNAL GENERATOR, TYPE "84," is available in two models with a frequency coverage of 100 Kc/s to 70 Mc/s and 30 Kc/s to 30 Mc/s respectively. The standard Advance decade step attenuator, accurate at frequencies up to 300 Mc/s, is used, and output from this is matched through a 75 ohm transmission line to the termination pad and standard dummy aerial network. Stray radiation is less than 1 microvolt.

Internal modulation, variable up to 50%, and also R.F. output, may be monitored by a crystal voltmeter. A 400 cycle A.F. output is available up to 15 volts and provision is made for external modulation.

Calibration is accurate to within plus or minus 1% and output to within plus or minus 1db. The direct reading dial is clearly engraved and setting is facilitated by a high quality slow motion drive, making this the ideal instrument for laboratory and production applications.

IMMEDIATE DELIVERY

Specially developed for both radio service and factory production engineers, the Type "F" Audio Generator has a frequency range of 0-10,000 c/s and is of particular interest. The range 100c/s-10,000 c/s is substantially level due to the use of a well designed negative feedback network and accurately calibrated to within plus or minus 2%.

Power output is approximately 1 watt into a matched load of 600 ohms, 5 ohms or 10 ohms attenuator and is monitored by a 2 range rectifier type meter. Total undesired signal is less than 3% at full output.

The dial is directly calibrated and is provided with a high quality drive, making this a particularly flexible instrument for audio frequency measurements.

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sistance of 5000 ohms and with the ginal base removed, its weight is luced to 2oz. This relay is rugged ough to withstand vibration, easy adjust, and is reliable on 0.5mA rrent charge and positive on mA.

A 950 1.5v cell will supply the fila-ent, and 467, 67.5 volt minimax high tension is recommended.

Although batteries can account for lf the weight of receiving equip-ent, the very miniature battery pes are not recommended. The all saving in weight does not com-nsate for too frequent renewals, d it should be remembered that the ialler batteries' higher internal re-stance can change the receiver's eration completely over a small riod of time. Always check the ceiver tuning **after** fresh batteries ve been installed.

JNING

Tuning adjustments being fairly itical, a metering resistor has been cluded in the receiver's high ten-on positive lead. Its value is chosen that the particular 0-1mA meter ed will read 5.0mA full scale. This sistor enables the meter to be con-ected in and out of circuit without sturbing any adjustments.

Keep the meter leads very short, better still, fit banana type plugs the meter and equivalent sockets the receiver.

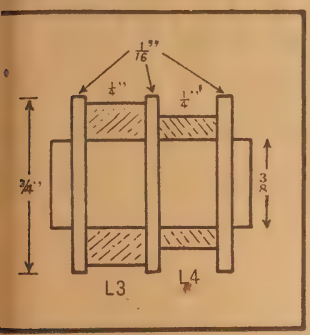

Fig. 8.—Details of the 30Kc quench coil. L3 has 1050, and L4, 700 turns of 38 B & S S.S.C. wire.

A tightly wound-up rubber band is bout the lightest and most practical eservoir of energy in small quantities nown, and it powers the new types f escapement to be described. The tandard escapement shown in fig. , connected to a rudder, operates in he following manner.

With the rubber motor exerting a urning force in the direction of the rrow, (a) indicates the control arm n neutral. The transmitter "ON" vill energise the coil, and allow the ontrol arm to go half right to (b). Transmitter "OFF" will let the scapement complete the first cycle nd the rudder go full right (c). There it stays until the transmitter is perated again, when the escapement oes half neutral, and with transmit-er off, back to neutral.

Any further transmission repeats his cycle, only giving left rudder this ime. The advantage claimed for his escapement is that current is only required to take the rudder from

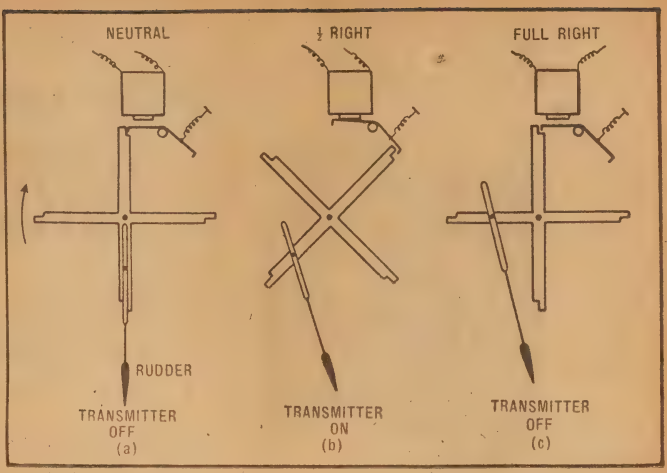

Fig. 9. — Standard escapement - operating cycle.

one position to another, not to hold it there.

The self-neutralising escapement of fig. 10, requires only one transmitter pulse to take the rudder, say, right. It will stay there as long as the transmitter is "on"; returning automatically to neutral, when the control signal ceases; the next pulse taking the rudder left, and so on.

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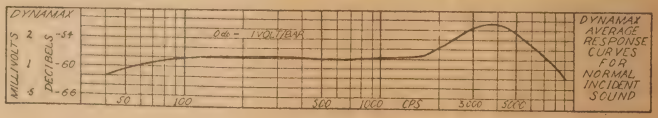

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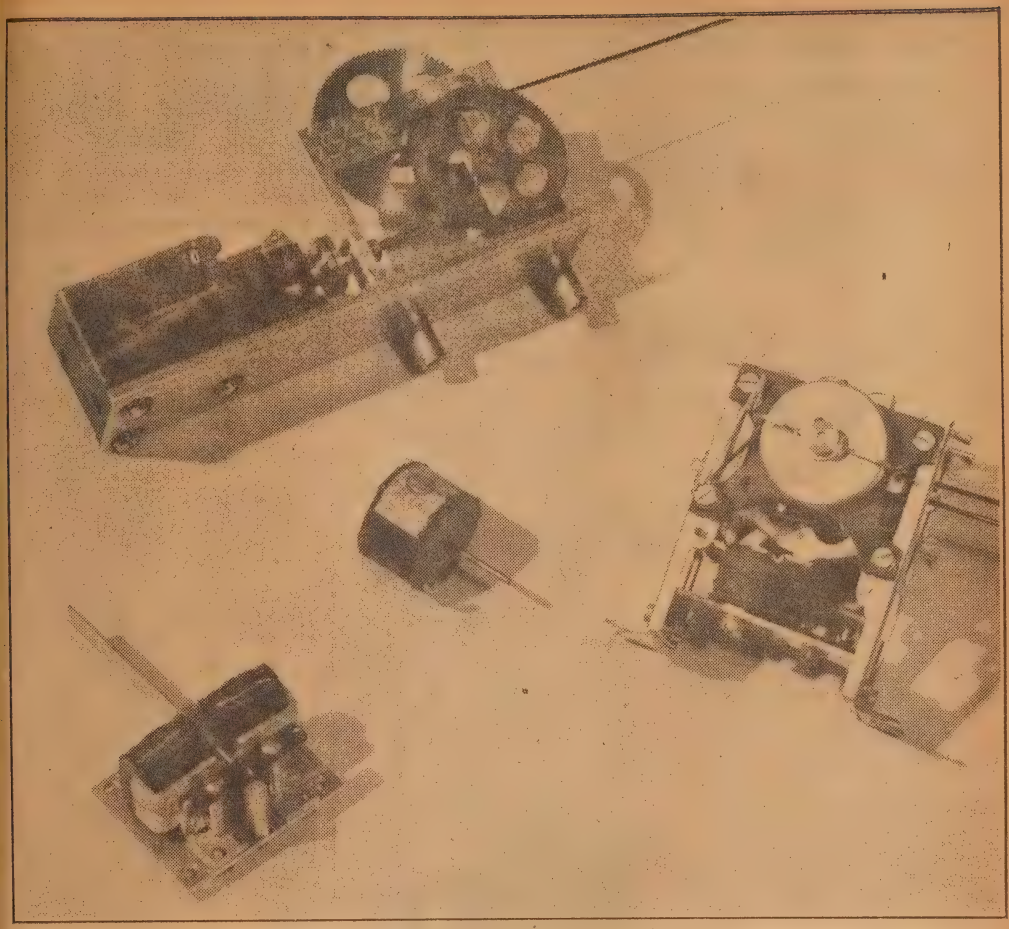

Fig. 12. — Details of motors discussed in the text.

The circuit diagram of fig. 11 depicts a motor-driven control unit which is operated by the same sequence type of transmission as the escapement just described. A small motor drives through a train of gears to the control wheel "A," fixed to this wheel are the cam and control pins.

The closing of the receiver relay contacts, by the transmitter pulse, starts the motor. The cam moves and switch S1 closes the motor circuit, and the motor will continue to run until the cam has made a quarter revolution, so opening S1. The control pins on wheel "A" are coupled to the rudder by small cables. As the control wheel moves in the direction of the arrow, a quarter of a revolution for every transmitter-pulse, the rudder will move in sequence from right to left, with a neutral between each position.

Shown in the photograph of fig. 12, are three types of control units, as well as a small motor. The motor in the centre of the picture, known as the "electrotor," about 1in in diameter, is made in the models 1.5v, 3v and 6v. Due to the peculiar construction of the armature, they all have a dead spot from which they will not self-start. They are still small and light enough, however, to consider coupling two of them to the

(Continued on Page 103)

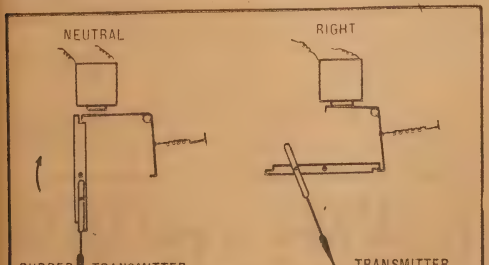

Fig. 10. — Self neutralizing equipment.

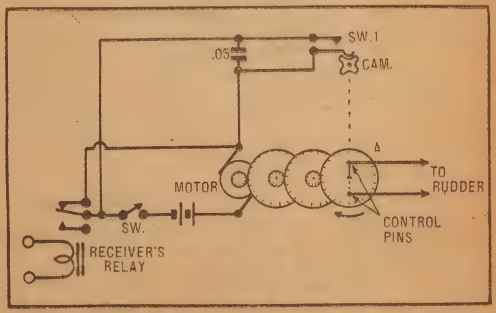

Fig. 11. — Sequence motor control unit.

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9 x 12, £5/19/6. 12 x 12, £7/15/-.
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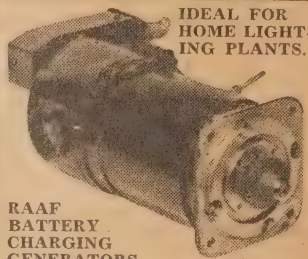

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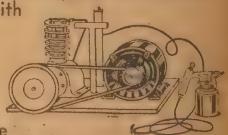

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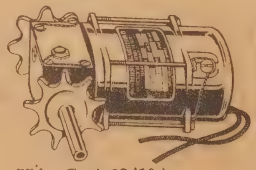

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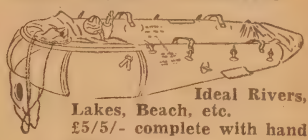

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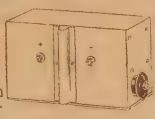

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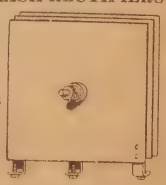

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SHORT WAVE NOTES BY RAY SIMPSON

NEW SCHEDULES FOR N.Z. STATIONS

In last month's issue we wrote a paragraph on Radio New Zealand, but before it was on sale, alterations were made in frequencies and call letters. On 29th July two new stations came into use, ZL8 on 9.62 mc and ZL10 on 15.22 mc.

THEIR new schedule is as follows: 4.00 am to 6.45 am on ZL3, 11.78 mc, and ZL8, 9.62 mc; 7.00 am to 4.45 pm on ZL4, 15.28 mc, and ZL10, 15.22 mc; 5.00 pm to 9.30 pm on ZL3, 11.78 mc, and ZL8, 9.62 mc. It is understood that this new schedule will continue till the end of October and possibly longer.

Radio Australia alterations

Our own Radio Australia has also announced changes in their schedule which affects the programmes directed to the British Isles, North America, Africa and French possessions in the Pacific. Their new schedule is as follows:

VLB3, 11.76 mc, 4.55 pm to 6.15 pm, to British Isles.

VLA8, 11.76 mc, 6.00 am to 9.00 am, to British Isles.

VLB6, 15.20 mc, midnight to 1.00 am, to North America.

VLB9, 9.58 mc, 1.15 am to 2.15 am, to Africa.

VLG11, 15.21 mc, 5.45 pm to 6.45 pm, French possessions.

STATION ADDRESSES

OZF.—The Danish State Radio, Radiohuset, Rosenornsalle 22, Copenhagen, Denmark.

OXI.—OY Yleisradio Ab., Fabianinkatu 15, Helsinki, Finland.

FRANKFURT. — Hessischer Rundfunk, Escherscheimer Landstrasse 10, Frankfurt, Germany.

ATHENS.—National Broadcasting Institute, 4 Righillis Street, Athens, T1, Greece.

VP4RD.—Trinidad Broadcasting Co. Ltd., Broadcasting House, Port of Spain, Trinidad.

HP5J.—La Voz de Panama, Servicio Publica de Radio, Box 34, Panama City, Panama.

WRUL.—World Wide Broadcasting Foundation, Box 320, Hatherly Beach, Scituate, Mass., USA.

CHNX.—The Voice of Halifax, Broadcasting House, PO Box 400, Halifax, NS, Canada.

VE9AI.—Edmonton Broadcasting Co. Ltd., Birks Building, Edmonton, Alta., Canada.

YNEQ.—La Voz de la Victoria, Apartado No. 3-3-8, Managua, Nicaragua.

ZYS8.—Emissoras Associadas, Caixa Postal 252, Sao Paulo, Brazil.

Korean Stations Still Heard On 7.96 Megacycles

KOREA.—This country is in everyone's mind at the present time and unfortunately it is something much more serious than the identity of a short wave station. Despite the unfortunate hostilities which are now in progress their short wave stations are still on the air. The South Korean station at Seoul, HYKA, can still be heard nightly on 7.96 mc, though of course it is now in the hands of the North Koreans.

The North Korean station at Pyongyang is also still on the air over JWM, on 4.5 mc, and is also sometimes audible on their other outlet of 7.785 mc.

LATEST CALL SIGNS FROM U.S.A.

THROUGH the courtesy of the Universalite we are able to publish a complete list of the new call letters assigned to USA stations.

6.06 mc Tangier II, 6.08 mc Munich III, 6.08 mc WLWO1.

7.215 mc Tangier I, 7.25 mc Munich IV, 9.515 mc KRCA1, 9.53 mc WGEO1, 9.53 mc Manila III, 9.54 mc Munich II, 9.57 mc, KWID1, 9.57 mc WRUL4, 9.57 mc KWID2, 9.65 mc KRCA2, 9.65 mc WABC1, 9.67 mc KGEI1, 9.67 mc WRCA6, 9.7 mc KRCA2, 9.7 mc KCBR2, 9.7 mc WLWO8.

11.71 mc WLWO7, 11.847 mc WGEO2, 11.71 mc WLWO5, 11.73 mc KGEI2, 11.77 mc WRCA5, 11.79 mc Honolulú 1, 11.79 mc Tangier 2, 11.79 mc WRUL4, 11.79 mc WRUL1, 11.86 mc KWID2, 11.87 mc Munich 1, 11.89 mc Manila 1, 11.9 mc KWID1.

15.105 mc KGEI1, 15.13 mc KRCA1, 15.21 mc KCBR2, 15.21 mc Tangier 1, 15.13 mc WRCA1, 15.24 mc WLWO5, 15.25 mc Tangier 2, 15.25 mc KRCA3, 15.25 mc Honolulu 2, 15.25 mc WLWO5, 15.25 mc Manila 2, 15.27 mc WABC2, 15.28 mc Munich 1, 15.285 mc WBOS1, 15.29 mc WRUL1, 15.31 mc WRUL3, 15.31 mc KCBR1, 15.33 mc Manila 1, 15.33 mc Manila 2, 15.33 mc WGEO1, 15.33 mc WGEO2, 15.33 mc WLWO6, 15.35 mc WLWO5, 15.35 mc WRUL1, 15.35 mc WRUL2.

17.75 mc WRUL4, 17.75 mc WRUL5, 17.76 mc KWID1, 17.765 mc WGEO3, 17.77 mc KCBR3, 17.77 mc KCBR2, 17.28 mc WRCA2, 17.78 mc Manila 3, 17.8 mc Honolulu 1, 17.8 mc WLWO7, 17.8 mc WLWO2, 17.83 mc KRCA3, 17.83 mc WABC3.

21.46 mc KRCA1, 21.5 mc WABC6, 21.52 mc WLWO3, 21.57 mc Manila 2, 21.57 mc WABC1, 21.59 mc WGEO2, 21.61 mc WRCA3, 21.65 mc WLWO7, 21.73 mc WRCA6, 21.74 mc KCBR2.

Latest Verifications

PEKING, CHINA.—With conditions as they are in China it is surprising that all verifications at all come out of this country. Arthur Cushen was therefore very pleased to receive one from Peking confirming his reception on 15.06 mc. The state that they are on the air from 6.30 pm to 1.30 am on both 15.06 mc and 10.26 mc.

Their address is Peking Broadcasting Station, 3 St. Si-chang-A, Peking, China. A few weeks ago this station was being heard quite well on 15.06 mc, though we inclined to wander around quite a bit between 15.03 mc and 15.07 mc. Mail are apparently still being delivered to the part of China.

OMDURMAN, SUDAN. — Quite an interesting letter was received from Mr. M. M. Eid, the broadcasting officer at Omdurman, confirming our reception of the station on 9.746 mc. In his letter he said that they were now using both 9.746 mc and 5.975 mc from 2.15 pm to 2.45 pm every day except Saturday from 2.30 am to 4.0 am and 5.0 am to 5.30 am; Saturdays from 2.30 am to 3.30 am and 5.0 am to 5.30 am; Fridays from 6.0 pm to 7.30 pm, and Saturdays from 12 midnight to 1.0 am. English can be heard on Saturday from 3.30 am to 4.0 am. This station also sent a very interesting book, Sudan Almanac, which gives much interesting information concerning the country.

OZU, DENMARK. — The Danish State Radio are very interested in listener reports, and as a help in identifying their stations they also announce in English. Their latest verification card received was for OZU, on 7.26 mc, confirming report of last April.

ZYS8, BRAZIL.—After a rather long wait Art Cushen has received a very nice verification from ZYS8, Radio Difusora de Amazonas. With the verification was a very nice letter in English from the managing director, Jose Eduardo, who states that they were anxious for further reports. The actual verification was a photograph of the Civic Theatre, Manaos.

The letter was sent by registered air mail, the address being Radio Difusora de Amazonas, ZYS8, Rua Joaquim Sarmento 100, Manaos, Brazil. This station is now transmitting on 4.805 mc with a power of 5 kw and on a favorable night it can be heard exceptionally well around 8.30.

NEWS ITEMS ABOUT SAUDI ARABIA

Some months ago we gave details of test transmissions being carried out from Saudi Arabia on many different frequencies. Once again it is our well-known New Zealand listener Art Cushen who is the first to give full details of the station taken from it's verification which he has just received.

THE verification took the form of a long letter sent by air mail and written by John E. Morrow, giving an insight into this interesting station. The station commenced operations on September 26, 1949, is located in Jeddah, which is on the Red Sea. In addition to the transmitters at Jeddah there are small studio facilities.

Each year 300,000 pilgrims pass through Jeddah on their way to Mecca. Due to Mecca being a non-Moslem forbidden area the studios which are being built in that city will be handled by Moslems only and linked with the transmitters at Jeddah by VHF-FM.

The transmitters are six 3 kw and the present frequencies are 3.95 mc, 5.975 mc, 9.65 mc, 11.85 mc, 11.95 mc, and 725 kc on the broadcast band. Due to slow progress the VHF-FM has not yet been completed, and consequently all programmes are at present originated in Jeddah. The schedules at present are subject to change, as the station is primarily intended for religious purposes, programmes being all in Arabic and under Government control.

The engineering staff at Jeddah are all Americans, while the Mecca staff are all Egyptians. Various antenna are used such as 9.65 mc rhombic on Bahrein Island, 56 deg. 11.96 mc on Baghdad, 25 deg. 11.85 mc on Damascus, 10 deg. 5.975 mc on Cairo, 330 deg. 3.95 mc on an axis of 67 degrees. 6.1 and 6.17 mc were also rhombic.

Their present schedule is 5.30 pm to 6.15 pm, 1.40 am to 2.16 am, and 3.30 am to 4.45 am. Both the 5.30 pm and 1.40 am sessions may soon be changed, though the 3.30 am transmission is permanent.

Mr. Morrow said in his letter that QSL cards were now being printed. Congratulations, Art, on this your 131st country verified, and many thanks for the above information.

EW STATIONS F THE MONTH

'OLOMBIA. — Our mystery Colombian ich we listed last month as being heard 5.965 mc has been identified by Art shen as HJCP and slogan appears to be de Bogota. They are still being heard te well opening at 9.40 pm, followed a minutes later with a few bars of nbeth Walk and then the BBC English Radio session, which continues till und 10.0 pm, when the call letters are en again.

here is a strong Morse station a few away from HJCP which sometimes kes reception rather difficult. Art has o heard this station in the afternoon, so far we have logged them only at ht.

L SALVADOR.—Another of our stations last month whose call sign we could distinguish has turned out to be YSC. is station has improved since last month d is now very good when they come on air at 9.55 pm, when they give opening nouncement, call letters and slogan. ey are known as Radio Mil Vienticinco d use a three-note chime at times.

The announcement is very rapid, but the ters YSC can be followed if you listen refully. Art Cushen put us right on this e as well and states that he can hear em in the afternoon till closing at 3.0, ough once again it is only at night that ey seem to be audible in this part of the rld. The frequency of YSC is 6.015 mc.

HONDURAS.—Just after we went to ess last month we managed to identify e station on 6.025 mc which we thought be Guatemalan. It turned out to be ROW, Radio Montserrat, in Tegucigalpa, nduras. This identification was also nfirmed by Art Cushen and an English rrespondent.

This station also comes on the air at 5 pm and after announcement by a lady ey go into their usual marimba type isic, which continues till after 10.30 pm. eir closing tune is Concerto For Two, nich can be heard when they leave the at 3.0 pm, and as this is a well-known mber listeners should have no difficulty identifying this station. Actually, this e has been testing for some considerable ne now.

ITALY.—We are beginning to wonder w many more frequencies the Italian ople are going to use for their various ansmissions, as we have now heard them still another two, namely 17.765 mc and 8 mc. The best time to listen for these ations is around 11.0 am, as they are in glish at that time, which makes identiation easier.

The 17.8 mc outlet can also be heard om 10.0 am till 10.53 am with a programme rected to North America, while at the me time 17.765 mc is carrying a different ssion directed to Mexico. At our locaon the 6.01 mc outlet is still the loudest ound 7.0 am.

PHILIPPINES.—Still another new station om the Philippines, this new one being YH4, operating on 6.055 mc. The best ne to hear it is from around 8.30 pm. when HJEX in Cali, Colombia, comes the air it completely blots out DYH4, HJEX is much the louder of the two. ey give their call letters as DYSR 830 your dial, and DYH4 short wave located Ilo Ilo City, Philippines. They have parently been testing, as they frequently k for reports from listeners.

We thought we may have had a reply om them in time to include in this onth's notes, but at time of writing it had t arrived. This is the first station we ve heard from Ilo Ilo City, as the ajority of the Philippines are in Manila.

GERMANY.—For some weeks now we ve been hearing a station on 6.13 mc ery morning broadcasting in both rench and German, mostly the latter. ey can be heard as early as 6.0 am and e still there when the band folds up st after 8.0 am. They give identification ite often, which always sounded like adio Europa Lederer.

According to Sweden Calling DX-ers the lle of the station is Radio Free Europe nd is located in the US zone of Germany

NEW STATION LOGGINGS

Call	Kc	Metres	Location	Time heard
HJCP	5965	50.28	Bogota, Colombia.	9.45 pm
YSC	6015	49.88	San Salvador, El Salvador	10.00 pm
ZEAF	6020	49.83	Salisbury, Sth. Rhodesia.	5.30 am
HROW	6025	49.79	Tegucigalpa, Honduras	10.00 pm
DYH4	6055	49.55	Iloilo City, Philippines.	8.30 pm
Free Europe	6130	48.94	U.S. Zone, Germany.	6.30 am
ZL8	9620	31.19	Wellington, New Zealand.	6.30 am
CE970	9780	30.67	Valparaiso, Chile.	10.00 pm
ZL10	15220	19.71	Wellington, New Zealand.	4.00 pm
Rome	17765	16.88	Rome, Italy.	11.00 am
Rome	17800	16.85	Rome, Italy.	11.00 am

Shortwave Flashes From Everywhere

LIBERIA.—This is a country which few listeners have heard or verified, and it was therefore very interesting to hear from a recent session from Radio Australia that there was now a short wave station in operation. This station is supposed to be on the air under the call sign ELBC from 6.0 pm using 6.025 mc.

The power is between 500 and 1000 watts and it is stated that they will later use other channels under the calls ELB2-3-4-5-6. Their address is given as Liberian Broadcasting Co., National Drug Building, Monrovia, Liberia. There is also word of another station, ELM, the Voice of Liberia, but we have no further word of this one at present. Keep a lookout for these new ones.

BRAZIL.—From the latest issue of Radio News and Television we learn of a new station in Brazil. This newcomer is known as Radio Record and is located in Sao Paulo and is said to be on the air from 9.0 pm to noon on either 9.59 mc or 9.595 mc, though Art Cushen reports having heard them on 6.06 mc in the early afternoon. When testing they used the medium wave call PRB9, but no call has yet been heard for the short wave outlet.

Their address is said to be Radio Record, Rua Quintino Bocaiuva 22, Sao Paulo, Brazil. The writer has heard a new station around 7.30 am operating on 9.605 mc which quite likely may be Radio Record, as it certainly sounds like a Brazilian and is quite apart from ZYC8, on 9.61 mc.

PHILIPPINES.—The Philippine stations do not seem to be verifying listeners' reports as readily as formerly, and it therefore is rather difficult to keep track of the new ones. A new one reported a few months ago, DYB2, on 4.985 mc, is new believed to be operated by the Bacolod Broadcasting Corporation.

Their broadcast call is DYBR, which uses 1120 kc, and station is known as Voice of Bacolod. No verifications have been reported from this one or from DZI3, on 6.11 mc, which we reported in the May issue. We hope that this month's new one, DYH4, on 6.055 mc, will decide to acknowledge reports from listeners. There is also supposed to be a station operating in Davao, but no reports of a short wave outlet as yet.

BELGIAN CONGO.—In addition to the Leopoldville stations OTC, OTH, OTM, &c., there are also one or two other stations in this country which have been heard from time to time. The best heard of these is OQ2AB, in Elizabethville, which transmits on 7.15 mc and 11.9 mc. The address for this station is Radio Elizabeth, OQ2AB, A. F. M. Schovens, Box 1039, Elizabethville, Belgian Congo.

Another Elizabethville station is OQ2AC, which uses 3.39 mc, 4.98 mc and 7.2 mc, their address being College des Francais, De Sales, Elizabethville.

Schedule for OQ2AB is 11.0 pm Sunday to 1.0 am Monday only, and OQ2AC is on the air daily 2.30 am to 3.15 am and on Sunday only from 5.0 pm to 6.0 pm.

CAMEROONS. — We receive very few reports of reception of Radio Douala, in the French Cameroons, and in fact have heard it ourselves only on two or three occasions. Reports have been sent off each time, but still there is no sign of a verification coming along.

It is gratifying, therefore, to know that this station really does verify on some occasions, as in the latest issue of the Universalite a US reader reports having received one signed by a Mr. F. Fournier.

The station's call letters are FIA6 and it operates on 9.15 mc with a power of 600 watts, using a delta aerial direction NW by SE. Their schedule is from 5.30 am to 6.15 am, including Sundays. Programmes are in French and they identify themselves as Radio Douala.

SPAIN.—Radio SEU, or to give their actual call letters EDV10, have just sent along a very attractive illustrated brochure giving details of their station. Although all in Spanish we have ascertained that the station is operated by the Sindicato Espanol Universitario and was inaugurated on 5th June, 1941, with a power of 200 watts.

SHORT WAVE NOTES for the October issue are due on September 9. For the November issue they are due on October 7. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, N.S.W.

,nd is on the air from 3.0 am till 9.0 am. Strength is usually quite good and we hope by next issue to have something more to tell you regarding this station. It is also being heard quite well in New Zealand.

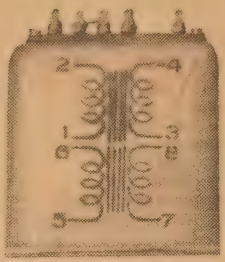
SOUTHERN RHODESIA. — Moving now to the Dark Continent we have noticed ZEAF, in Salisbury, Southern Rhodesia, using the new frequency of 6.02 mc till leaving the air at 6.0 am. At 5.0 am on a Saturday they give a programme entitled Sportlight, which surveys the colony's sport and included interviews with the Australian Soccer team and other interesting items.

At 5.30 am they change to a musical programme, and this continues till the station closes at 6.0 am with announcement by lady "Goodnight, wherever you may be." It all sounds very English and reminds you of the BBC type of programme. On the day we heard them they were coming in at quite good strength.

CHILE.—This is not a new station but rather a change in frequency of a very old one. While listening on the 31 metre band one night we were surprised to notice CE970 operating on 9.78 mc instead of their usual channel of 9.73 mc. The time was just after 10.0 pm, so we presume they came on the air at that time. They can easily be identified by their announcement, La Voz de Chile Para Toda America.

Another easy way to identify this station is by their opening number, Land Of Hope And Glory, and their location, Valparaiso. A few years ago they used to give opening announcement in English from their sister station CE1190, but this now seems to have been abandoned.

AMATEURS — DISPOSALS — EXPERIMENTERS



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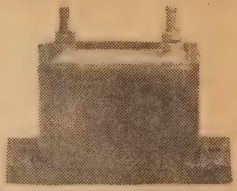

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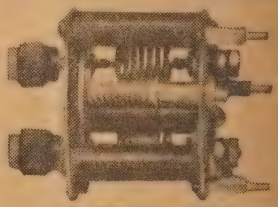

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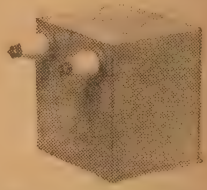

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THE HAM BANDS WITH BILL MOORE

The major contest of the year, the VK-ZL International DX Contest will be run during September and October. The two national societies, the New Zealand Association of Radio Transmitters and the Wireless Institute of Australia invite amateurs throughout the world to participate.

It is not anticipated that the conditions on the 28 and 14 mc bands will improve much by then, so the lower frequency bands 3.5 and 7 mc will receive more attention. Anyone who does enter is ensured of some interesting contacts.

The following are the objects and rules:—

Objects—for the world to contact Australian and New Zealand amateurs.

The contest is divided into two sections, CW and Telephony, and the periods of operation for each are as follows:—

CW.—1201 GMT, 22nd Sept. to 1159 GMT, 24th Sept., and again from 1201 GMT, 6th Oct. to 1159 GMT, 8th Oct.

Telephony.—1201 GMT, 29th Sept. to 1159 GMT, 1st Oct., and again from 1201 GMT, 13th Oct. to 1159 GMT, 15th Oct.

Duration.—(a) VK and ZL stations for contest purposes will limit their period of operation to any consecutive 24-hour period on each weekend within the times given above. Once an operator commences he must not exceed 24 hours of consecutive operation reckoned from each commencing time.

(b) In other countries stations may contact VK and ZL stations at any time within the periods shown above.

Rules.—1. There shall be three main sections in the contest—

(a) Transmitting CW.
(b) Transmitting telephony.
(c) Receiving (telephony and CW).

2. The contest is open to all licensed transmitting stations in any part of the world. No prior entry need be made. Mobile marine or other non-land based stations are not permitted to enter the contest.

3. All amateur frequency bands may be used.

4. CW will be used for the first and third weekends, telephony for the second and fourth weekends. Stations entering for both Telephony and CW sections must submit separate logs for each.

5. Only one contact per band per weekend with any one station (for contest purposes) will be permitted.

6. Only one licensed amateur is permitted to operate any one station under the owner's callsign. Should two or more operators operate any particular station, each will be considered a competitor and must submit a separate log under his own callsign.

7. Before points may be scored for a contact, several numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of the RS (Telephony) or RST (Telegraphy) reports, plus three figures, which may begin with any number between 001 and 100 for the first contact, and which will increase in value by one for each successive contact. Eg, if the number chosen for the first contact is 53, then for the second contact the number must be 054, for the third 055, and so on. If any contestant reaches 999 he will then start from 001 and continue.

8. Scoring—Fifteen points will be scored for the first contact on a specific band, with any overseas country (VK-ZL districts for overseas stations), fourteen points will be scored for the second contact on the same band with the same country (VK-ZL district), thirteen for the third and so on, to the fifteenth contact, which will score one point. All contacts with that particular country (VK-ZL district) on that band will thereafter count one point each. This scoring procedure will be repeated on each band, to encourage multiband operation. There will be no VK-ZL contacts between each other. ARRL official countries lists will be used. VK-ZL districts are VK's 1, 2, 3, 5, 6, 7 and 9. ZL's 1, 2, 3, 4.

9. Logs—a. Logs must be shown in this order: Date, time in GMT, band of operation, call sign of station contacted, serial number sent, serial number received, points claimed.

b. A separate log must be submitted for each band. For each band an analysis sheet must be given showing: List of countries (VK-ZL districts) contacted, with the number of contacts and points claimed for each country (VK-ZL districts) contacted.

c. A summary sheet to show:—

1. Station call sign; 2 name and address of operator; 3, whether phone or CW; 4, points claimed for each band; 5, grand total of points; 6, brief description of transmitter, tubes, power, antenna, &c.

d. A declaration that all contest rules and regulations for Amateur Radio in your country have been observed, and that the log is correct and true to the best of your belief.

10. The judges reserve the right to disqualify stations for: a, Consistent tone reports under T8; b, continuing key-clicks; c, phone splatter and/or over-modulation; d, off-frequency operation.

11. The ruling of the Executive Council of the NZART will be final, in the event of any dispute.

12. Overseas stations should call CQ VK-ZL and VK-ZL stations CQ Test.

13. Awards: Attractive certificates will be awarded to the station returning the highest score from any particular country and each call area in the USA. Additional certificates may be issued at the discretion of the contest committee. VK and ZL awards will be announced by the WIA and NZART, respectively.

14. Entries from overseas stations should be plainly marked on the wrapper, "VK-ZL Test," and forwarded to reach the NZART, Box 489, Wellington, NZ, by January 14, 1951. Logs from NZ stations should reach the same address not later than November 24, 1950, while VK logs should be sent to their respective divisions by November 24, 1950.

RECEIVING STATIONS

1. The rules for the Receiving Section are the same as for the Transmitting Contest, but is open to all members of any short-wave listeners' society in the world. No transmitting station is permitted to enter for the receiving contest, too.

2. The contest times and the logging of stations once on each band per weekend are subject to the same rules as for the transmitting contest, except that, VK and ZL listeners may listen and log stations over the whole period of the contest. Logs will be in the same form as for the transmitting contest.

3. To count for points, the callsign of the station being called, the strength and tone of the calling station, together with the serial numbers sent by the calling station must be logged. Points will be claimed on the same scale as for transmitting stations.

4. It is not sufficient to log a station calling CQ Test.

5. VK receiving stations cannot log VK stations and ZL receiving stations cannot log ZL stations, but VK's may log ZL's, and vice-versa. Overseas stations will log only VK and ZL stations heard operating in the contest.

6. Certificates will be awarded, as in the transmitting contest.

Conditions at the time of writing are extremely poor on both the 14 and 28 MC bands, and it is hoped that some improvement will be shown before the end of September. Stations entering are assured of an interesting and enjoyable time, and all are wished the best of luck in the VK/ZL test.

OVERSEAS

THE Amateur Radio broadcasts sponsored by the ARRL and presented over the Voice of America by Bill Leonard, W2SKE, are now transmitted on a different frequency schedule. Broadcasts to the Far East and Latin America are made at 1345 GMT, Sundays, on 9515, 9570, 9650, 11,730, 15,130 and 17,830 kc/s. This broadcast is relayed in the Far East by transmitter on 920, 11,790, 11,890, 15,250, 15,330 kc/s. The Broadcast to Europe is at 1915 GMT, on Sundays, on 15,270, 17,780, 21,500 kc/s, and relayed in Europe on 7200, 9700 and 15,230 kc/s. Both sessions are received reasonably well here on a suitable frequency.

Another interesting broadcast on amateur affairs is given from OTC in Belgian Congo on 9767 kc/s, using their new 50 kw. transmitter. The programme of 20 minutes covers general amateur news, interviews with Belgian and foreign amateurs and reviews of amateur radio periodicals. The broadcast is made in three languages—English, Dutch and French. The English session is given at 2040 GMT each Wednesday. Roger Allard, ON4RA, prepares the programme, and they are received here in excellent strength.

The 25th September sees the commencement of the Extraordinary Administrative Radio Conference, to be held at The Hague. The main business concerns the re-allocation of all frequencies below 28 mc/s for the various countries. The list, which will be presented to the conference has been prepared by committee which has been sitting in Berne for a number of years. We should soon learn after the completion of the conference when our 21 mc band will become available.

Amateur societies will be represented and delegates from the RSGB and ARRL will be in attendance with their national delegations.

The annual session of the ARRL Board of Directors was held late in May. Most of the discussions centred around the organisation of the League itself. The more interesting decisions are as follows: A drive will be held during the next year to increase the full membership of the League by 10,000 (full membership is available to VE, W, and American territories amateurs). The feasibility of a teletype assignment between 7250-7300 kc's is to be investigated.

Committees will consider and work on expansion of 160 metre facilities, urge voluntary use of 29.6-29.7 mc's for exclusive mobile operation, effect liaison with the Federal Public Housing Authority in connection with regulations governing antennas and masts in housing projects (regulations at present exclude erection of beams on such projects).

PHONETICS

SOME time ago the WIA proposed to the IARU that a standard phonetic alphabet be adopted throughout the world. The matter was incorporated in an IARU calendar and all National Societies voted in favor of the idea.

The alphabet proposed and adopted was the inter-services one, used by the Allied Nations in the last war, and is the one recommended by the PMG in their Handbook for the Operators of Amateur Wireless Stations.

Generally speaking, the use of fancy phonetics so prevalent a few years ago has fallen from favor, and most amateurs use similar phonetics to the following accepted list: A—Able, B—Baker, C—Charlie, D—Dog, E—Easy, F—Fox, G—George, H—How, I—Item, J—Jig, K—King, L—Love, M—Mike, N—Nan, O—Oboe, P—Peter, Q—Queen, R—Roger, S—Sugar, T—Tare, U—Uncle, V—Victor, W—William, X-X-ray, Y—Yoke, Z—Zebra.

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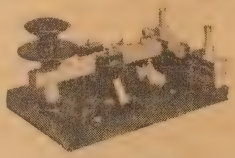

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DX AND PERSONAL

ITED NATION officials in the Middle
Cast have been responsible for some
esting amateur activity.

ex-SM has used the following calls,
JN, ZC6UNT, ZC6UNJ and is at
nt using SV5UN. Cards for any of
above calls can be directed to SV5UN,
ed Nations, Island of Rhodes.

I8AD Martinique cards in most cases
be obtained by forwarding your
and a reply coupon to W4AZK, who
ontrolling the distribution of the
cards. Both W4AZK and W4CEN
done a fine job, the latter after
hours' operating time, took a copy
M8AD's log for a long period.

:8GRC, operating portable from the
pagos Is., worked 2116 stations during
seven-day stay QSL cards are ai-
y arriving in Australia

e DX man is experiencing a very
time at the moment Conditions
worse than at any time since DX was
e a business.

ck Pike, VK2JP, reports that VK1PG,
Heard Island, an ex-VK2, sends
wishes to the VK2 W1A crowd, and
them to look out for him. He
been worked at 0830 hours EAST
frequency 14,360. Jack also men-
that ZM6AA has just come on in
sh Samoa on telephony 14,300 kc/s.

aham Goodge, VR2BC, heard 26 VK's
ZL's on 50 mc during last season,
worked quite a number of them
e then on a number of occasions
ers have appeared, but were too
to be identified.

d-timer PK3LC reports that he is
n going strongly to reach his 7500
collection of prewar (he lost that
during the Japanese invasion).
is over the 2000 mark already; he
mentioned that the NIVIRA, the
h East Indies National Society, passed
of existence this year. Formed in
the PARI now takes its place.

e old society was very active, and
o the commencement of the war ran
own B/C station on normal B/C
encies.

ngratulations to Mae Robinson,
HT, Alf Moye, VK2BW, and Brian
hell, who received certificates from
Police Department for their very fine
ts during the Wagga floods this year.

W.I.A. NEWS

the recommendation of the Hunter
Branch of the NSW Division of WIA
ed Dr. Adcock an honorary life-
ber. Members of the RAAF will
mber the Adcock D/F stations, the
l system of which was originated
Dr. Adcock. Now a resident of New-
e, the doctor has presented several
res to the Hunter Branch.

e lecture at the July meeting of
NSW Division was presented by Mr
y Stowe, Chief Electrical Engineer
he Sydney Water Board. His sub-
"Electronics in the Board." Equip-
t to be used for communication
oses during the construction of the
ragamba Dam was on display, and
se was explained by Laurrie Hughes,
QP.

rry Stowe is a foundation member
he WIA in NSW, and is now an
rary life-member. He was the
nal A2W1, and his own call was
K.

veral changes have taken place in
organisation of the NSW Division.
chnical committee has been formed
its main function will be to assist
bers with technical advice. The
bers of the committee are Vaughan
on, VK2VW, chairman, Joe Reed,
VR, and Dave Duff, VK2EO. Ques-
can be directed to the Box No.,
GPO, Sydney.

embership of the WIA throughout
ralia is growing rapidly. A point of
est, a recent list issued by the
showed 11 new amateurs in NSW,
in a month nine of these had joined
WIA.

OUR OPPORTUNITY—

in the world-wide ranks of amateur
mitters! The Wireless Institute of
ralia holds regular classes in Sydney
sist Sydney and suburban enthusiasts
btain their Amateur Operator Cer-
tes of Proficiency.

e for particulars to the Class Man-
W.I.A., Box 1734, G.P.O., Sydney.

NEW VALVES FOR OLD

(Continued from Page 43)

that they use the button base and eliminate wasteful internal leads. For this reason, they do show improved short-wave performance, even over the popular Australian-designed 2.0-volt series.

Here the story ends, however, because their electrode structures do not boast the close spacing and high gain figures necessary for extended V.H.F. performance. After all, they were designed primarily for portable use and close spacing, &c., would be a source of failure, particularly with a directly heated filament.

BRITISH TYPES

Finally, readers may have wondered at the variety of unfamiliar British types which have been introduced in recent months. We refer not to miniatures, many of which do come from England, but to valves like the X61M, the KT61, the KT66 and a variety of other types intended for ac-dc operation.

The reason for their appearance locally is economic rather than technical. There are many types for which there is a moderate demand in Australia but not enough to justify local production, which must necessarily be on a mass-production basis. In the past, such valves were imported from America but dollar shortages and other considerations have switched the source of supply to the UK.

Fortunately, standardisation between England and America has proceeded to the point where many of the valves in question use the same base and even the same pin connctions as more familiar types. The KT66, for example, can be regarded as a replacement for the 6L6 in most applications.

Once again, the home-builders need not worry too much about these types. The only thing strange about them is the type number and valve charts are available to tell as much of the story as one cannot remember.

OFF THE RECORD — NEWS & REVIEWS

The advent of the micro-groove records has thrown emphasis once again on the needle or stylus point. Over the years, records have been made with varying groove widths and shapes, each of which requires a different stylus shape and/or diameter for best results. Once again, the search is on for an all-purpose needle.

By JOHN MOYLE

AS we have pointed out in previous articles, correct point fit has a marked effect not only on reproduction, but also on surface noise.

It seems generally agreed now that the best type of needle is one with a rounded tip, and of a diameter which allows the sides of the tip to rest in the groove near the bottom but without actual contact with the bottom. In this position, the tip can follow the groove shape most efficiently, without getting jammed in the corners on the one hand, or skating about on the bottom of the groove on the other.

The earlier records were made with fairly wide grooves, which for this and other reasons seem to play best with a needle tip about 3.5 mils in diameter (1 mil equals one thousandth of an inch). Records of today, however—that is the 78 rpm types—do best with points between 2.5 and 3 mills. The RMA standard tip is given as 2.7 mils which, from our own experience checks in about right.

The micro-groove records, however, require a point of 1 mil diameter, or about one third of the 78 rpm standard. It is with the intention of discovering what happens when a point somewhere between these two dimensions is used that work is now being done.

The problem can be tackled by using the smallest possible point on 78 rpm and checking its results on micro-groves, or using the largest permissible on micro-grooves and checking on the 78 records. In addition to experimenting with point diameter, further work has been carried out with tip shape, and by varying the sharpness of the point—to put it more exactly, by varying the angle contained by the sides of the tip itself.

COMPROMISES

From what I have been able to observe, none of the compromises so far suggested has shown promise of worthwhile results, even if one is prepared to lose a certain amount of the high frequencies in order to reduce the effects of distortion which follows a poor stylus fit.

A point diameter of 2 mils, for instance, isn't really bad for 78 rpm records. It sits in most cases very near to or on the bottom of the groove, and therefore produces a high scratch level. Its tendency to "skate" isn't hopelessly bad.

But used with micro-grooves, if reports are correct, it's just too big. I'd be inclined to think its disadvantages here would rule it out. Inevitably, it would ride in contact with the upper edges of the record groove, and this is bad on almost every count.

Firstly, this type of needle point inevitably wears "shoulders" on the tip, as it tries very hard to grind itself into the shape of the too fine grooves. These shoulders mean that the needle must be discarded early in its normally useful life, otherwise the irregular shape would play havoc with both types of records.

RECORD WEAR

In this connection, the micro-grooves are likely to suffer to a greater extent than the 78 rpm. The material used is not remarkable for its hardwearing qualities, and although the weight of the head is much less than the older type, it is concentrated on a much finer point. The actual pressure per square inch—in other words, is probably much the same for less robust record material.

Apart altogether from the matter of record wear, the distortion in the upper register brought about by a grossly large point and its inevita-

ults is quite serious. The sug-tion has been made that, given airly severe top-cut in the ampli-, it can be largely removed. hough this may be partly true. l although in a compromise de-n some fidelity may be sacrificed. is only a back-door type of solu-n which has little appeal to me.

No, it seems as though a better proach must be thought out if the ne pick-up is to be used for 78 l micro-grooves.

One of these is already exampled this country by the Goldring ple, who have produced a new gnetic cartridge with interchange-e stylii. The cartridge is of the edle-armature type, and this, added careful design, has resulted in a ry good job. The frequency range good with no undue peaks right up 20 kc and at only a few narrow pts throughout the range is wave-m distortion noticeable.

The necessity to change the stylus ch time the change is made from to 33 isn't much of a nuisance, rticularly when we remember that have had many years of chang-g needle points for every record.

FFERENT HEADS

Other pickups are available with erchangeable heads, each fitted th a stylus of the required point ameter. Connoisseur, I believe, ve such a head, and the new Acos P20 uses the same idea.

In America, there are pickups ailable with two stylii permanently ted, one above and one below. change from one to the other, the ad is simply turned through half revolution. There doesn't seem uch wrong with this idea in prin-ple, but, inasmuch as both stylii rm part of the armature, it might difficult to avoid bringing its sonance low enough down the ale, because of the extra mass of e second stylus.

I think, therefore, that the micro-ooves will be best considered on eir own as far as such require-ents are concerned. Although I, for e, would not object to changing head or a stylus to accommodate em, I think the idea of a single ylus for each type represents too uch of a compromise to be enter-ined, except where record wear d high quality are not important. aybe they might have an applica-on in juke boxes.

UTOMATIC STOPS

Another sidelight on the micro-oove records is their doubtful per-rmance with the present day auto-atic stop mechanisms, to say nothing record changers, although the lat-r are, I hope, due for a well merit-l funeral.

A microgroove pickup, with about ven grams of weight applied, and fine, one mil point, isn't the best ing to use for pushing around an utomatic stop, particularly when s movement gets a bit heavy through ear, dust or sticky oil. Moreover, e compliance of such a pickup must e quite high, and the displacement f the stylus right at the end of e record where it is most undesir-able, can't be considered a good thing.

One need not entirely abandon automatic stops, however, if they are considered essential. I could suggest on the spur of the moment that a simple, mercury type switch could be perfectly satisfactory, as it requires very little push to tip it to one side and thus break the circuit made initially by the tiny mercury pool.

So far, I have heard very few claims on behalf of the microgrooves for extremely high fidelity. Their performance in this connection has, of course, been mentioned, but it doesn't seem to have been stressed as a major selling point. Perhaps this is because the long playing feature is considered to be the best plugger, or it may be that so far manufacturers haven't been satisfied altogether with their results in this respect.

I don't think it's fair for me to comment very much on this point, because, frankly, I don't think the records I have heard to date have been really good examples. My impression of them has been that they are inclined to be patchy, with some very poor examples mixed up with others which are mighty good.

I do feel pretty confident, however, that we need have no doubt about the eventual quality of microgrooves. I believe, too, that we will soon get used to the fact that we must handle them more carefully in every way than the long suffering 78's. The day will come when we will wonder just how we put up with wearing a path through the carpet to change records nine or 10 times during a symphony!

HOME RECORDING

The fun of making one's own recordings seems to be growing more and more in popularity, from what I can see, with a varying interest in the claims of discs, tapes, and wires.

At the moment, only the discs seem to be catered for to any extent for the average experimenter, although there are recorders using the other types with a more or less commercial appeal to them. A goodly cross section of more advanced readers have made attempts at home-manufacture of them all, and some appear to have obtained really good results.

In my view, the disc is hard to beat for general use, as much for its convenience as anything else. For more serious work, however, tape and wire have plenty in their favor, particularly when long playing is wanted.

We are continuing experiments from time to time with disc recordings. Only the other day, the BRS people sent me along one of their latest recorders and discs, and I intend to see what can be done to produce a design which can be built up.

Recent articles indicate the broad lines along which the result will emerge, although, at this stage, I can't say just when it will be forthcoming.

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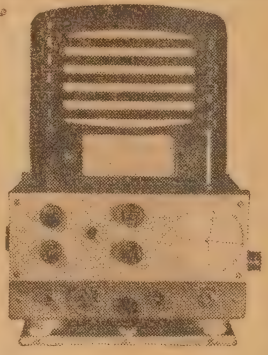

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32 ,,	275 ,,	100 ,,	3	10	0
24 ,,	300 ,,	215 ,,	2	5	0
12 ,,	325 ,,	50 ,,	1	10	0
12 ,,	550 ,,	160 ,,	5	10	0
24 ,,	550 ,,	160 ,,	4	0	0
24 ,,	315 ,,	200 ,,	3	0	0

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ROM THE SERVICEMAN WHO TELLS

(Continued from Page 35)

with the possible arrival of
ision. If things like that can
en on a few hundred volts, what
utions will be necessary for pic-
tube circuits which run at any-
between 7 and 15 thousand

en the deflecting voltages can
uite high and enough to make
look twice at the insulation.
e's nothing like being cheerful!
back to servicing.
e little meter I wrote up a few
graphs back nearly came to
rry end this morning. It hap-
d this way:—

NT SET

4-valve mantel receiver came in
service. The owner explained
it must be a valve because the
lit up and therefore the power
getting to the set. He seemed
surprised when I explained
everything could appear nor-
all the valves be alight, and
the set remain stonily silent.
nge how people automatically
e the valves for a failure.

e set was completely dead and
uld not hear even a whisper of
from the speaker. A shorted
us line, the usual explanation for
mplete failure, causes the recti-
to get pretty hot, but this one
relatively cool. What went on?
e set was removed from the
net, switched on with one hand
e I reached for the meter with
other. Just then, I was called
y and the set was switched off
n.

oming back five minutes later I
the general impression that the
ker field was probably open so,
iout switching on again I
nged the prods over to "Ohms"
proceeded to take a reading.
pointer flew over with a click
could be heard all over the room.
I had been trapped.

The field was indeed open and the brief period when the set had been switched on previously had been sufficient to charge the input condenser. Being a good one, it had retained its charge—a matter of nearly 400 volts.

When my poor unsuspecting meter was connected across the terminals of the open-circuited field coil, one side was virtually earthed through the B-plus circuit in the rest of the set, putting the whole of the voltage across the meter. The pointer was bent slightly but otherwise undamaged.

If you want to bend a meter pointer in this fashion, there is actually no need to run a drill into the speaker field. It is rather expensive, like the old Chinese method of roasting pork.

All you have to do is to switch the set on without the speaker and its field plug in. When switched off again, the input condenser will be nicely charged and the stage all set to give yourself a "belt" or ruin your pet ohmmeter.

BOOK KEEPING

By way of conclusion, I made a few wisecracks some issues back about keeping books and making up tax returns. However, I can well imagine, in these complicated days, that such matters are a real problem to many servicemen. Not being a financial or bookkeeping wizard myself, I won't undertake to suggest ways and means.

However, I have a very good friend who knows all about columns and figures and I am trying to persuade him to invent a system for servicemen. Don't be surprised, then, if your serviceman article takes a very different form next month.

PUTTING YOUR CRO TO WORK

(Continued from Page 39.)

ep. The nature of the pattern
cates that the signal on the
ical plates has twice the fre-
ncy of the horizontal deflection.
other words, the characteristic
re 8 shape, lying sideways, indi-
s a predominantly 100-cycle
ponent, arising from the filter
uit.

his would obviously be the case,
e the instrument was connected
ctly across the first filter con-
ser.

y disconnecting the lead tempor-
y and substituting an input from
audio generator, we determined
t the pattern height corresponded
a voltage of 10 RMS. In other
rds, there were 10 volts of hum
oss the condenser.

he set actually had two con-
sers in parallel in this position
disconnecting one of them more
n doubled the height of the trace (figure 6). The effect of extra capacitance on the hum level could thus be observed very readily.

Measurement across the second filter condenser indicated a very small ripple voltage indeed. It was necessary to turn the amplitude control to maximum and even then only the faint suggestion of a figure 8 pattern could be detected (see figure 7). This was measured as being equivalent to .04 volt RMS.

Related to 250 volts d-c, it represents a ripple percentage of .016.

Disconnecting the first filter condenser naturally dropped the HT voltage and increased the hum level to an objectionable percentage. The effect on the CRO screen is indicated in figure 8. The pattern is highly irregular in shape but the double loop characteristic is still apparent, indicating the predominance of the 100 cycle filter component.

THE 1950 PENTAGRID FOUR

(Continued from Page 59)

ture valves when plugging them into their sockets. Take it easy and gently slide them into place. Ideally, a dummy plug or a valve should be inserted into each socket during the socket-wiring process to avoid misalignment of the sleeve contacts.

Connect the speaker via its plug and socket at the rear of the chassis. The speaker should have the usual transformer mounted and suitable for a load impedance of around the 10,000 ohm mark. Switch the set on again, connect an aerial and turn up the volume. In most cases you will be able to tune-in a station even before the alignment procedure is commenced.

DIAL ADJUSTMENT

However, before going any further, adjust the dial drum drive on the tuning gang so that there is equal overlap of the pointer at each end of the dial travel.

Now tune down toward the high frequency end of the dial and select a station. Adjust the aerial trimmer, that is, the one nearest the dial, for loudest volume from the station. Identify the station and, if it does not coincide with its marking on the dial glass, adjust the oscillator trimmer a little at a time until it does. Having done that, readjust the aerial trimmer for maximum volume. You may find it necessary to follow each adjustment of the oscillator trimmer with readjustment of the aerial trimmer to keep the station loud enough.

Now swing the tuning up toward the low frequency end of the dial, that is, toward the end where 2FC appears. Identify a station, note its position on the dial and adjust the slug protruding from the bottom of the oscillator coil until the station is tuned in at its correct position on the dial. While listening to this station adjust the slug protruding from the bottom of the aerial coil for maximum volume.

FINAL CHECK

These adjustments may have altered slightly the situation down toward the other end of the dial so chase up the station which you had tuned in before and go through the adjustments of the oscillator and aerial trimmers as mentioned earlier. If the necessary readjustment was of some magnitude, recheck the setting of the slugs at the other end again. This will not usually be the case, however.

Now select any station on the dial, preferably a weak one, and adjust the slugs protruding from both the top and bottom of each I.F. transformer for maximum volume, starting with the No. 1 transformer. Go through this procedure twice to counteract any interaction between windings.

That's all there is to the alignment procedure. It isn't as complicated as it might sound and can occupy less time than it takes to

(Continued on Page 103)

ANSWERS TO CORRESPONDENTS

R.N.N. (Ayr, Q.), sends a subscription for Radio and Hobbies and a copy of the "Short Wave Handbook" when available. He also sends a problem for the "Answer Tom" section, gives some details of converting a No. 19 army set to a short wave set, and also asks about the availability of tropic proofing solutions.

A. Many thanks for your letter R.N.N. and the subscriptions have been forwarded to the appropriate department. Your contribution for "Tom's" page is also being handled and should appear in due course. Your conversion job makes interesting reading and as you say should give excellent results. The phone circuit has been used before R.N., or at least arrangements very similar, but if you worked it out yourself, all duc credit to you. Glad you like "The Serviceman," who appreciates your remarks. Regarding tropic proofing. We suggest you contact some of the large manufacturers of paints and varnishes. These firms apparently did most of the research in this field during the war.

H.R.C. (Cobden, Vic), thanks us for information supplied through the Query Service which has enabled him to improve the characteristics of a bass boost circuit.

A. Many thanks for your report and we are pleased to note that the amplifier is now performing in a better fashion. We are also pleased to note that you liked the top-cut filter which we agree is absolutely essential with the combination of present day gramophone records and high fidelity loud speakers. Most enthusiasts using similar equipments have had the same experience as you mention.

J.S.T. (Cooks Hill, Newcastle), forwards a couple of suggestions for our "Reader Built It" Page, one being a circuit sent to him by an American experimenter.

(A). Many thanks for your contributions J.S.T., and we have noted your circuit for future use. The crystal triode circuit is quite interesting, and appears to follow fairly standard practice in the use of these devices. It is not likely to be of a great deal of interest to Australian readers however, as unfortunately these units are not available in this country.

W.R.C. (Victoria): Advise of a change in amateur call sign, and requests that it be included in the "Call Sign Handbook."

(A). Your notification arrived rather late. However your entry now appears as VK3ARC, as it should be.

L.H.C. (Nutgrove, Qld.), congratulates us on the high standard of the magazine and at the same time asks a number of queries.

Many thanks for your very kind remarks with regard to Radio and Hobbies. Your expression of interest is greatly appreciated. We would not advise connecting headphones in the plate circuit of a 1L5-G since the plate current is likely to be .6 mA. or greater which is more than most headphones are designed to carry. A better scheme would be to place a choke in the plate circuit and connect the phones between plate and ground. A coupling condenser of from .1 to .5 mfd. should be included, of course, to isolate the plate voltage from the phones. The choke could conveniently be the primary winding of a speaker transformer. The secondary winding could be left disconnected or a permagnetic speaker could be connected to it if desired. Both of your modulated circuits appear to be in order. The primary winding of a push-pull audio transformer could be used in place of the centre tapped choke specified. Some adjustment of the parallel condenser may be necessary in order to obtain a satisfactory audio note. As you suggest, shorting the audio output terminals should stop the modulation but if the effect is not complete it would be permissible to increase the value of the coupling condenser. The thickness of twelve copies of Radio and Hobbies varies from volume to volume and in following the binding instructions in the February, 1949, issue it is necessary to make allowances for this. Among the test equipment we have already described are included several signal tracers and modulated oscillators but we have not yet described a valve tester due to the difficulty in obtaining the special components wanted in the required quantity and quality.

C.W.W. (Lakes Entrance, Vic.), is operating a 6J7-G pre-amplifier under the usual resistance coupled audio amplifier conditions but with a supply voltage of 400. He wonders if he should use a dropping resistor.

(A). No series dropping resistor is required to satisfy valve operating conditions but it may be desirable to employ a decoupling resistor of, say, .1 megohm and a by-pass condenser of 8 mfd. to prevent coupling through the power supply with resultant low frequency oscillation or motor-boating. Since the valve is operating at a low level the position on the operating curve is not critical.

E.M.McF. (Windorah, Q.), sends a circuit of a short wave converter which he is using in conjunction with the "Reader Built It" published in R & H for July, 1950, and suggest that it might also be suitable for publication in the "Reader Built It" section.

(A). Many thanks for the circuit, which we have filed for possible future use. Strictly speaking this is not what is known as a converter, which term is usually reserved for those units which operate on the superhetrodyne principle. The unit you have described is generally referred to as an adaptor, and the idea was a very popular one in the days before the superhetrodyne was in common use. Being a regenerative short wave set it should be capable of very good results, always provided that it is correctly handled.

E.T.E. (Randwick, NSW) says he is very keen on the "Simplified Superhet" in the August issue. He suggests that we should describe a short-wave unit for it, also a record-player attachment.

A.—Many thanks for your encouraging remarks and we trust that you will be well over your sickness by this. We have covered the record-player angle but are not so sure about the short-wave "unit." We are trying to keep the "Kit" series to essentially simple projects and the idea of a short-wave or dual-wave version may not fit into this plan. We prefer to reserve judgment on that for the time being. In the meantime, the Australian Short-wave Handbook contains details of a simple short-wave converter which could be used ahead this set.

E.E.D. (Sydney, NSW) says he likes circuit of the simple superhet in Australian Short-wave Handbook. Ho ever, he has had difficulty in obtain the necessary 2.0 Mc. I.F. transforme

A.—Actually the term 2.0 Mc. is rather broad one and it would be p sible to use transformers resonating a where near this frequency. The Ac Mfg. Co. produces 1900 Kc. (1.9 M transformers as a standard line, wh there have been quite a few 1600 transformers around the shops, ta from disposals equipment. Either t could be used without alteration to circuit or coil data. We would advise you to use 455 Kc. transform however, as the image response wo be adversely affected.

A.C.D. (Northcote, Vic.) wants ditional information on loudspea baffling methods.

A.—Sorry but we cannot give you information over and above that wh has already been published in p issues. We rather feel that you have s this from your reference to spea "ports." However, just to repeat details of a vented enclosure it sho have an internal volume of about cubic feet for an ordinary light d 12in. speaker and up to eight cubic for the larger, heavier type with a cycle cone resonance. The cabinet ne to be built from heavy timber, prefers one inch thick and lined with some so absorbent material. The vent should proximate 0.8 times the area of the c opening but it can be located in position which happens to balance appearance of the cabinet. Your i of using the tapestry covering for speaker hole is quite a good one, p ticularly as it is of such open weave

H.I. (Kalgoorlie, WA) sends in the cuit of a DC mains operated dou push-pull amplifier for possible use the Reader Built It page.

A.—Many thanks for the circuit, wh will be filed for consideration as you quest. We agree that the method controlling the volume offers ser problems in this type of amplifier. So form of ganged potentiometer wo probably be the only really satisfact solution.

A.T. (Beecroft, NSW) sends in a cuit for comment. It appears to be attempt to combine, in a small set diode detector and a triode amplifier

A.—Apart from the desirability otherwise of such a combination, circuit contains several fundame errors. The filaments of both the tector and amplifier sections are op ted from the same supply without provision for rendering them inde dent with regard to audio currents. grid and filament of the output valve directly connected together by vi of this circuit, which means that would not amplify or even pass a nal. If a single valve operating a leaky grid detector is used, there is point in having a separate diode. would suggest, therefore, that you fo a standard one-valve circuit. Such circuit is available through the shil query service and we would be plea to forward a copy to you on reques

F.H.M. (South Brisbane, Qld.) write tell us about a large dual-wave rece he has constructed by combining a n ber of Radio and Hobbies circuits.

A.—Many thanks for your letter we are very glad to note that you h found so much of interest in our ma zine over such a long period of t The set certainly sounds a big job. might be possible to cure the sl instability you mention (probably mo boating) by operating one or more the voltage amplifier stages directly f the filament of the rectifier rather from the normal high tension supply separate decoupling resistor and denser would be necessary, of course

YOUR QUERY?

1. Queries will be answered in rotation through the columns of our magazine if not accompanied by a fee for a postal reply.
2. Queries, neatly and concisely set out, will be answered by mail as quickly as possible if accompanied by 1/- in postal notes or postage stamps. Endorse envelope "Query."
3. Back numbers are rarely available but reprints of most circuits, wiring diagrams, and parts lists will be supplied for 6d each, minimum charge 1/-. Thus a circuit, layout, and parts list will cost 1/6 in stamps or a postal note. Endorse envelope "Circuit."
4. Blueprints of exact size chassis layouts with all essential holes, and cutouts will be supplied if available for 2/6. Endorse envelope "Blueprint."

Address your letters to the Technical Editor, "Radio & Hobbies," Box 2728C GPO, Sydney.

ANSWERS TO RRESPONDENTS

(Footscray), Vic.) wishes to know have the circuit of a one-valve r on file.

Yes. We have details of at least one-valve receivers in our files ould be pleased to forward any them to you on receipt of the 1/- query fee. One circuit uses olt type 30 valve, while another e 1.4-volt type 1Q5-GT. The third uses the 2-volt 1K5-G and may special interest to you since the is available at an especially re- price.

(Dubbo) sends a subscription l and makes some encouraging nts about R. and H. He also s that we test some of the record rs on the market at the present nd comment on their performance. Your subscription has been for- l to the appropriate department, and many thanks for your kind s. We are glad you like the "Off ecord" feature. We have not had opportunity to give the various of record-changers a thorough ut, but we may be able to pub- mething on the subject in the

(Chatswood, NSW) has a com- l communications receiver which ot tune the broadcast band. He s if it is possible to make a con- to feed in at 1700 kcs., the lowest ncy to which the set tunes. The circuit of such a converter ot present any problems and could along the same lines as the S.W. ter described in the January, 1948, Use a standard broadcast band coil. The output coil can also be dcast aerial coil which, with the ifd. condenser shown on the cir- nitted, can be tuned with the approx. 1700 kcs. The oscillator owever, is a non-standard item. or coils for use with a 1600 kc. annel have been manufactured by t two companies, but it may be ry to try a number of radio houses before you can locate one. t decrease in the value of the capacitance may be necessary to good tracking.

N. (Sth. Brisbane, Qld.) tells us built the Jeep circuit, published October, 1942, issue of R. and H lthough very pleased with the would like to know if we have cuit diagrams of a set which is he lines of this set but employing stage, an audio driver stage and ll output. He makes mention of ve types which he has on hand, e of power transformer and of et that he wants to use a per- ic speaker.

lad to know that the "Jeep" pro- ood service, W.H.N. With regard r requirements of a larger set, ld suggest the 1946 Standard (B/C), was described in the May, 1946, f R. and H. This set employs he valve types down to the push- 6-G's in the output stage. Fur- re, there is provision for using p of standard type having reason- gh output. Incidentally, the pick- minals should be shunted with a of about 0.05 megohm to 0.1 n when using a magnetic type The 385 volt per side power rmer shown in the circuit diagram replaced by the 285 volt per side ich you have on hand. The 1000 lectrodynamic speaker field coil in the filter network should be and the electrolytic filter capa- increased to 16 mfd. If filter still apparent, it may be neces- add another filter choke and ytic capacitor to the filter, al- this should be avoided if possible, the output voltage from the first hoke will be down to between 1 250 volts as it is. An extra hoke will drop this figure to about 0 volts, depending upon its d-c ce and the actual HT drain when to a signal. However, the main from this lower voltage will be l audio output but the pushpull should be able to provide you uch more than you can actually general home listening. The 80 ectifier has the same electrical eristics as the 5Y3-GT and hence place it without any circuit change

Keep Your Queries to the Point!

ONCE again I must ask our readers to assist in making the query service efficent and helpful. Unfortunately for us, most people these days prefer to pay their 1/- for a postal reply rather than wait perhaps weeks for an answer in the Correspondents' Columns. I can't blame them for this, of course, but at present we have such a flood of shilling queries that I just don't know what to do about it.

At the moment, it is taking a great part of three men's time every day to find out the answers to your questions. This cuts into the normal work so much that I am doubtful whether it can go on. Particularly as the 1/- charge does not nearly cover the cost of time and office handling for such letters, many of which are really too wide in their coverage for us to handle quickly.

In the early days, I did not visualise the 1/- service as anything else than a quick way for a reader to get out of trouble experienced in building one of our sets. It was not meant to become a discussion centre for almost everything in radio, and from what I can see from the questions we are asked, that just about sums it up at the present time.

Now if we are to continue the service as at present, we must either be able to handle your queries more quickly, or charge more for the service, or cut it out altogether. The last I don't want to do, the second I'd rather not do, and the first we must do.

From now on, will you please make your questions short and to the point, numbering them if you like, which will help you to sort out your ideas before you write them down. Do not ask questions about general radio matters—that is why people write textbooks! Remember, our main object is to help you get your R & H receiver working, and from now on we may have to commence returning your money if the letter strays beyond the scope of the service.

I do hope you will help in this matter. It may be a compliment to us to deluge us with so much confidence and question. But spare a thought for my perspiring staff who must bear the weight, and please don't make it heavier than they can stand!

—THE EDITOR.

to the power supply wiring. The B/C version of the 1946 Standard did not incorporate a tone control, although, of course, negative feedback was used. The D/W version of this set as described in the June, 1946, issue of R. and H., included a tone control, the particulars of which are as follows: Between the plate of the "top" 6V6-G and the centre-tap of the output transformer connect a 0.1 megohm and a 0.02 megohm resistor in series with the 0.02 megohm on the transformer centre-tap side. Again between these two points connect in series a 0.002 mfd. capacitor, the outside ends of a 0.25 megohm potentiometer and a 0.01 mfd. capacitor, the 0.01 mfd. being on the transformer centre-tap side of this series network. Join the moving arm of the 0.25 megohm potentiometer to the junction of the 0.1 megohm and the 0.02 megohm resistors and from this point take a 0.25 megohm plate load resistor to the plate of the 6J7-G audio driver valve. This tone control arrangement is not new but it is quite effective.

Readers say:

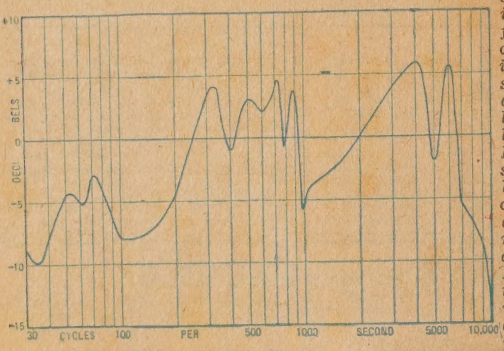
SHIELDED WIRE

I have been interested in recently published remarks on the effects of shielded wire in amplifier circuits. I have always had a sneaking suspicion of shielding, particularly long leads running from volume controls, &c.

On reading the aforementioned remarks I decided on an impulse to do away completely with all shielded wire in the audio section of my receiver by way of experiment.

Rather a drastic step to take, I might say, and one which I thought would most likely be a complete failure because of the instability and hum pickup. But I set to work and when I had finished I had plastic-covered wire running all over the place, draped across everything by the shortest possible route.

Well, I switched on and let her rip. It appeared to be better but most likely it was only my imagination, because at the maximum of 5 kc/s even, the capacity would not become very troublesome. By suitable adjustment of the I.F. channel, &c., I managed to obtain a very pleasing effect with cymbals and things beginning to faintly resemble their true sounds.



On recordings the amplifier seemed as though it had a rising treble characteristc because the high notes were scintillating, that is when you could separate them from needle scratch. This latter condition had me quite peeved for a while because I thought that the thing was all treble and no bass until I played a disc with plenty of cellos and bass drums, &c.

I suppose it wouldn't be a bad idea to mention here the method of speaker loading. It is mounted in a vented enclosure, and is a Rola 8K, which is supposed to have a response from 80 c/s-6.5kc. The enclosure is made to dimensions (roughly) suggested in an article which I think appeared in June or July of 1947. It has a cubic capacity of 3.3 feet and is lined with an old blanket.

I thought it would be interesting to see just what a curve of actual sound ouput versus frequency would look like, so I bundled all my junk into the old bus and buzzed off into the Radio School at MTC where I attend. I set up my enclosure in a soundproof room with BFO feeding into the pickup terminals and a standard microphone set up at the same height as the speaker and about eight feet directly in front of same, the output feeding into a sound level meter.

I fiddled with the BFO while listening to the output and was pleasantly surprised to hear the output well sustained to below 30 c/s and above 13 k/s. I thought this was pretty good so I set to work with a friend and eventually completed a set of tabulations which in turn resulted in the curve enclosed. I showed the result to one of the instructors and he seemed to think it was not too bad but I pointed out the rapid falling off in the response above 7 kc.

Although the speaker response is supposed to fail here I did not expect to see it give up the fight so quickly, taking into consideration the apparent loudness as I listened to it. But I was surprised to learn that the db meter also fell off rather rapidly after 7 kc, so I thought things may not be as bad as they appeared.

Personally, I don't think it is so bad considering it is only a simple 2-valve amplifier with a high-mu triode for 1st amplifier.

OUR COMMENT

By way of comment, it would be impracticable to remove the shielding from most amplifiers, for the reasons you mention. The proper course is to arrange the layout so that long shielded runs are not necessary.

The setting of the volume control during the tests is not indicated but, as we pointed out, it can have a vital bearing on top response, particularly when feeding into a high-mu triode.

The curve of the treble response is inconclusive in detail, because of the db. meter limitations, but its general shape is more or less as we would expect it to be. Inexpensive speakers will reproduce 13 kc. without a doubt but at many db. below the output at middle frequencies. Your curve corresponds closely with a typical speaker cruve published on page 41 of the January, 1950, issue and this rather proves the point.

THE 1950 PENTAGRID FOUR

(Continued from Page 99)

read about it. The important point, however, is that the dial glass must match the type of tuning gang, otherwise the stations will not align up correctly.

You should find that the set will perform remarkably well for the number of valves and the power output should be quite sufficient for general home use. If you encounter slight instability when the volume control is turned up, particularly on a weak station toward the low frequency end of the dial, it could be due to a number of things, notably lengthy speaker leads or the speaker leads running close to the aerial lead.

The point is to keep the speaker leads down to the minimum length necessary for the cabinet installation and away from the aerial lead. Other measures include running a third wire to the speaker earthing the speaker frame and one side of the voice coil to the set.

A more elaborate course involves placing a resistor of about 0.05 megohms between the grid of the 3V4 and the junction of the 0.005 mfd coupling capacitor and the 3 megohm grid resistor. Install a 100 pF. capacitor from the grid of the valve to chassis.

The choice of cabinet is left to the individual. We actually had in mind a table-model size, with the set taking up one half of the cabinet and the speaker and batteries taking up the other half. Incidentally, don't expect the set to do a good job if fed into a small-size speaker. The eight-inch is a good all-round size.

MODEL PLANE CONTROL

(Continued from Page 86)

same shaft and so arranging the dead spots so that they do not occur at the same place or time.

The unit on the right is the English "Cossor" spring-driven escapement, with the clock-type spring housed in the circular cover at the side, and the magnet system underneath. Two control arms connected one to the elevator and the other to the rudder provide in sequence, up, down, left and right, with a neutral position between each. A pair of switch contacts "made" after each revolution of the main wheel can be used for engine ignition control if required.

Electronic Torch

HOT enough to cut holes in firebrick or to melt tungsten, a new torch utilizes the action of 1000-mc. radio waves on gases.

An antenna made of two short cylinders, one within the other, leads from the 1000-mc generator. A high-frequency arc can be formed on the end of the antenna.

When certain gases, among them nitrogen and carbon dioxide, are fed past the arc, a flame about 9in long is produced. The arc breaks up molecules of gas atoms. These atoms joining together again on any surface placed in the flame give off heat.

Printed and published by Associated Newspapers Ltd., at the registered office of the Company, 60-70 Elizabeth Street, Sydney, NSW.

Electronic Self-loading Camera

THE application of electronics opens new fields in the development of high-speed photography. The increasing use of the Cathode Ray Oscillograph in present day scientific, industrial and atomic research, calls for the recording of traces resulting from transient phenomena occurring in millionths of a second. To record these traces by normal photographic technique would require a film speed unattainable by mechanical means.

The problem has been solved after years of patient research by a British electrically controlled, self-loading camera.

Basically the camera unit consists of a 16in diameter drum, housing two spools with a total capacity of 100ft (30.48m) of 35 mm film, together with an automatic reloading mechanism. A 4.5in (139.7 mm) f/1.9 anastigmatic lens is fitted and the camera controls are centralised on an electronic control unit which is self-contained.

Operation of the camera is exceedingly simple. A motor is started; the drum slowly revolves. Electronic control is brought automatically into operation; speed increases; a rate of 3600 rpm is achieved. A triggering mechanism releases the cathode ray tube beam and an exposure is made (each exposure involves one complete revolution of the drum). The cathode beam is deflected, the drum reloaded. The camera is set for the next recording.

Wanted to Buy, Sell or Exchange

EXCHANGE: Complete Radio Eng. Course. 44 Copies R. & H. Valves, including (1D8GT, new). 6v. Trans. and sundries, for small receiver. **S. Ireland, 90 Asquith St., Auburn, N.S.W.**

EXCH.: Valves EBF35, EK32, 6SN7GT, (2) 6X5GT, 6SJ7GT, (2) P30 Trans., (2) 3" Speakers and require X61M, 6SK7GT, 6SQ7GT, 5Y3GT, 7" speaker (Trans. 240v. Prim., 290v. sec., 60mA), pair IF Trans. **Ring LU1386 and I will call.**

FOR SALE: Thornton Pickard ¼ p camera, F8 lens, 3 double P. holder Working order. £20 or offer. **B. Champion, Nowra, N.S.W.**

FOR SALE: Two 12-volt 500-watt generators. Good condition, but have no further use for them. Offer. **Loveday, Elimbah, Q.**

FOR SALE: Movie Projectors (silent, 35mm. £17. 16mm. £45. **No. 5403, Sun Advertising.**

FOR SALE: R. & H. Feb. '47 to May '50, incl. S.W. Handbook, minus March '47 and Jan. '49. Price £2/10/-. **141 Carlingford Rd., Epping, N.S.W.**

SALE: 5-valve A.C. Stromberg Carlson Aust. wide B/c reception—£10. 2-valve battery set with speaker, £7½. **L. Davies, Southport School, Southport.**

SALE: A.R.8 Receiver. **A. Cook, 490 Kooyong Rd., Caulfield, Vic. XM2724.**

SALE: Lexington m/c Pick-up, transformer, laboratory equaliser, 8 sapphires, £20 or offer. **A. Joachim, 17 Huntingfield Road, Brighton. XB3349.**

SALE: Radio College Ham Operators' (AOCP) Course, PMG Key, Morse Oscillator and phones, £5. **D. Adams, 81 Beaumont St., Hamilton, N.S.W.**

SELL: New 12w. amp. G12 SPKR, £17. New 5v. A.C./B.C. Mantel Chassis, £13. G12 SPKRS £4½ each. **A. W. Fuss, 49 Balmain Rd., Leichhardt, N.S.W.**

SELL: Radio and Television Course, and set three volumes Radio and Television, all new. Cost £23½, take £10. Sell separately. **Davies, Bronte Pk., Tas.**

SELL: R. & H. most copies since 1941. Single copies or as a whole. Stamped addressed envelope for reply. **W. MacGillicuddy, 23 Bangs St., Prahran, Melbourne.**

SELL: Rola 5" spkr., 1500 field, trans. at 15/-; 2 power transf. 280-45 mA., at 10/- ea.; 2 "H" 2-gang at 7/6 ea.; 1 R.C.S. DA2 dial and DA5 glass, at 7/6; Tasma baby 4v chassis with R.F. less cabinet and teries, £5/10/-, or offer. Details **T. A. Walker, Dulacca, W. Line, Q.**

SELL: Phillips Push-Button Tuner, complete with instruc £4/10/-. Aegis Coil Kit (special) to 200m in 3 bands. (3 stage), £8/-/-. **Reed, 10 Edgar St., Brighton, Vic.**

Readers wishing to buy, sell or exchange goods are invited to insert an advertisement on this page. The cost is 1/- per line; approximately 5 words to a line. Advertisements for the next issue must reach our office by NOON WEDNESDAY, September 12, 1950. Dealers' Advertisements not accepted.

SELL: 807 Triode Amplifier with control stage, "Axiom Twin Tweet Speaker, Decca FFRR PU (magnet brand new. HMV rim-driven gramophone motor. "Rolà" 12U Speed with OPZ5 10,000 ohm 2 PP Transfo "Vox Minor" 4½-watt Amplier, compl with Xtal PU and Amplion 12" Spe Best offers, Sunday or Tuesday only **Vivian, 37 Kensington Rd., Summer H**

SELL: Two good Type 3 Mk. II Tra ceivers, with modulators and Fo Packs. AR7 with ANL. EF50 RF supply, coil cabinet. Will sell separate What offers? **L. M. Bills, Gawler, S.A.**

SELL Transceivers, 2-FS6 comple New, Aerial, Wavemeter. £35 Lot. **West, 2 Queen's Rd., S.C.2., Melb.**

SELL: Brand New Collaro Elect turntable and Crystal Pick-up. £7/1 **Davies, 83 Fourth Ave., St. Peters, S**